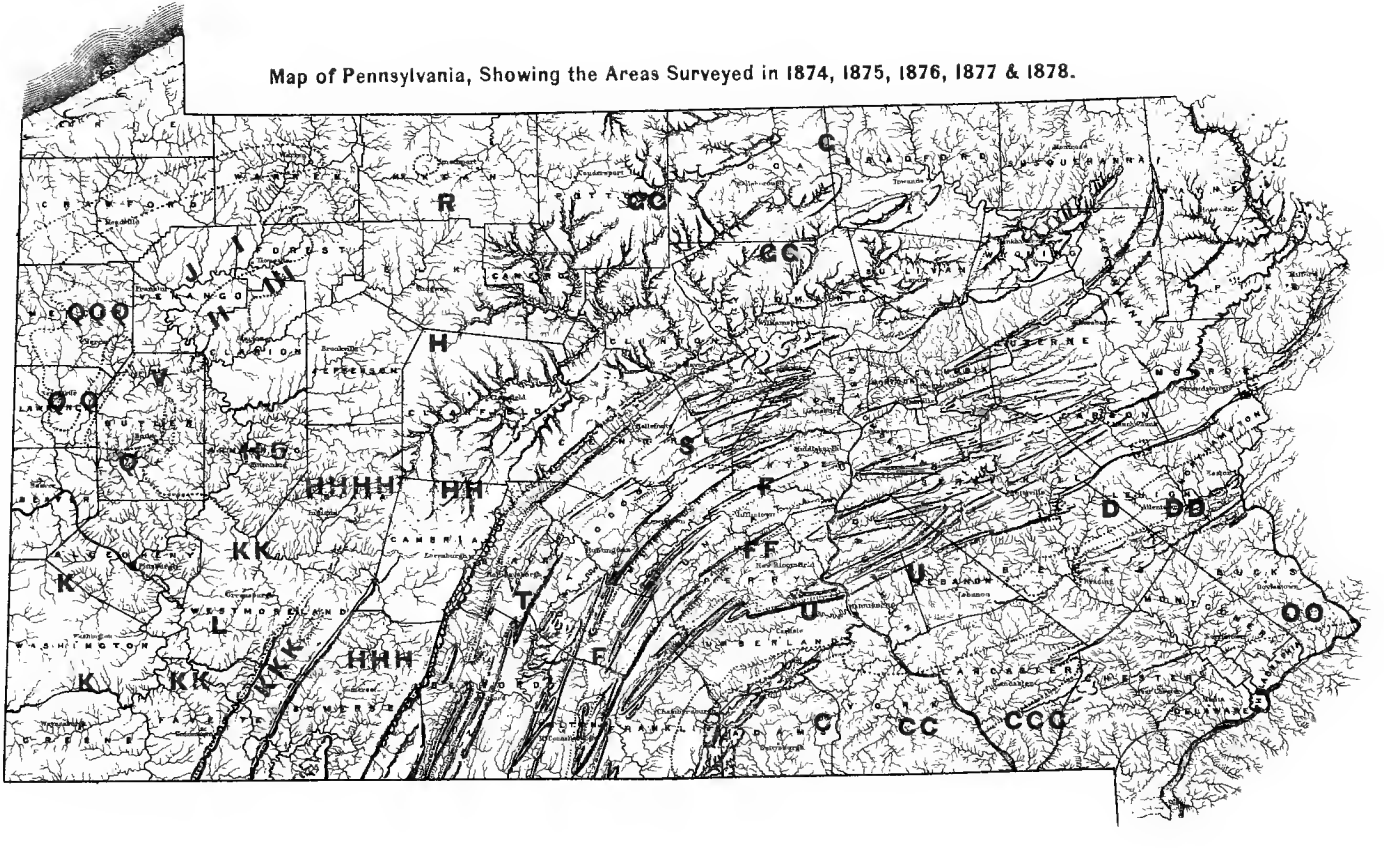
Map of Pennsylvania, Showing the Areas Surveyed in 1874, 1875, 1876, 1877 & 1878.



SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA:

REPORT OF PROGRESS IN 1878.

QQQ.

THE GEOLOGY OF

MERCER COUNTY.

BY

I. C. WHITE.

WITH A COLORED GEOLOGICAL MAP OF THE COUNTY AND 119 VERTICAL SECTIONS.

HARRISBURG:

PUBLISHED BY THE BOARD OF COMMISSIONERS FOR THE SECOND GEOLOGICAL SURVEY.

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PART II.—Detailed Geology.

West Virginia University,
Morgantown, *March 20, 1879.*

Prof. J. P. Lesley, *State Geologist:*

Dear Sir: I herewith transmit the results of my work in Mercer county during the summer of 1878. Field work was begun on the 20th of May and was continued with but one short interruption until September.

You will observe that I have modified my conclusions expressed in Q and QQ on two points; first, with regard to the transportation of the Erratics; and second, with regard to the geological horizon of the Sharon coal.

Respecting the Erratics I cannot imagine any stronger evidence than we now possess that their origin is directly connected with that of the Northern Drift.

To the following gentlemen among others I am under many obligations for favors to the survey:—Messrs. Oliphant and Lewis of Pardoe, Mr. Harmon McFall of Stoneboro, Mr. Walter Pierce and J. M. Goodwin of Sharpsville, Mr. Nichols, Mr. Bell and Mr. Boyce of Sharon.

Very respectfully,

Your obedient servant,

I. C. WHITE.

PREFACE TO QQQ.

The geology of Mercer County is rendered difficult by the almost universal covering of Northern Drift, which conceals most of the Coal Measure outcrops in the north-eastern townships, and much of the upland surface between the main streams in all other parts of the county.

This however has not prevented the author of this report from discovering and describing with sufficient fullness and in sufficient detail all the useful geological features of the county. Whatever uncertainties remain are not of an economical, but of a systematic character; but these should be pointed out to geological experts.

The first of these uncertainties respects the arrangement of the *Kittanning Group*.

It is noteworthy that while this group consists of three coal beds, *Upper*, *Middle* and *Lower*, there are few districts of north-western Pennsylvania in which all three are practicable in the same section. One or other bed of the group is almost always abortive; either wholly absent, or not distinguishable, or not exposed, or else represented by a very small layer of coal or coal slate. Nevertheless, in a few places all three beds are to be seen in the same section, each one of notable size.

This led Prof. White in his surveys of southern Butler, northern Beaver, Lawrence and Mercer counties, to consider the group as composed of only two beds, the Darlington above, and the Kittanning below. After the survey of Armstrong, northern Butler, Venango and Indiana counties had resulted in proving the triplicity of the group, the Darlington bed in Beaver county was at first identified with the *Middle* Kittanning, on the ground that it had but one coal bed under it.

Further observation has rendered it certain that the cannel bearing bed is the *uppermost* of the three Kittanning beds; and that it always (in the Allegheny river region) lies from 110′ to 120′ above the *Ferriferous Limestone;* and this is the position of the Darlington bed in Beaver county.*

In consulting this report then, the systematic geologist must interpret all doubtful references to the *Darlington* bed by this rule. If the bed be only 60′, 70′ or 80′ above the *Ferriferous Limestone* he has a right to reject the name Darlington and substitute for it the name *Kittanning Middle* coal; and that, even if there be no coal bed reported under it, in the interval over the limestone. Any bed, if there be such, beneath it will then receive the name *Kittanning Lower* coal.

The second uncertainty respects the *Clarion Group.*

Mr. White says in this report that he was at first inclined to identify the Pardoe and corresponding beds with the *Clarion* coal; but that he was afterwards induced to call the Pardoe bed the *Brookville* coal, because it lay so close upon, and in some places immediately upon the *Homewood Sandstone;* for, if it were the Clarion, then there would be no room for the Brookville under it.

But his first impression was no doubt correct; and the absence of the Brookville from its place under the Pardoe bed may be explained.

The geological arrangement of the Clarion group, in Butler, Clarion and Venango counties is thus described by Mr. Chance.

FERRIFEROUS LIMESTONE.
0′ to 20′, ... Shale.
Scrubgrass (Clarion Upper) *coal.*
20′ to 35′, ... Shale.
Clarion (Clarion Lower) *coal.*
20′ to 30′, ... Shale; sometimes friable sandstone.
Brookville coal.
0′ to 10′, ... Shale.
HOMEWOOD SANDSTONE.

* See, for example, page 199 Q and Fig. 172, Plate XIII, where it is 120′ above the limestone, and 40′ above the Kittanning *Middle;* the Kittanning *Lower* coal being absent, or concealed as a streak in the 70′ interval over the limestone.

Sometimes the Scrubgrass coal is the floor of the limestone; sometimes the Brookville coal has the sandstone for its floor; and sometimes the scrubgrass coal (for example when traced *southward** from Scrubgrass or Rockland to Martinsburg) is seen to descend until (at Martinsburg) it forms the top bench of the Clarion coal.†

But now, in some parts of Butler county the *Clarion coal* may be seen maintaining its regular distance beneath the Ferriferous Limestone, and yet, at the same time, lying close above the Homewood Sandstone. And in such cases the Brookville coal is absent from the interval. In some of these cases the sandstone is greatly thickened, upward. In other cases the sandstone is no thicker than usual, and the variation would suggest a gentle local anticlinal, or at least a swell in the water-floor previous to its deposit. In any view of the case the actual section at Martinsburg and its vicinity is as follows:—

FERRIFEROUS LIMESTONE.
20′ to 35′, ... Shale.
Clarion coal, . . { Scrubgrass bench. / Clarion bench.
5′ to 15, ... Shale.
HOMEWOOD SANDSTONE.

But when the section is made in the country to the north and west of Martinsburg it has the following aspect:—

FERRIFEROUS LIMESTONE.
0′ to 20′, ... Shale.
Scrubgrass (Clarion Upper) *coal.*
20′ to 35′, ... Shale.
Clarion (Clarion Lower) *coal.*
5′ to 15′, ... Shale.
HOMEWOOD SANDSTONE.

This is the state of things not only on Scrubgrass creek in Venango county, but on Wolf creek on the western edge of Butler county. But in the central parts of northern Butler county the top of the sandstone often lies 30′ to 40′ lower, allowing the *Brookville coal* (4′ to 6′ thick) to lie

* Not northward as intimated on pages 27, 28.

† See Report V, page 30, Plate 1. In Report VV Mr. Chance will give facts collected more recently in Clarion county to prove this union of the two beds.

upon it; with an interval of 25′ to 30′ up to the *Clarion coal* (2′ to 3′ thick); and 15′ to 25′ higher lies the *Scrubgrass coal.*

There are therefore good reasons for calling the Pardoe bed the *Clarion coal;* and it may very well be that the *Brookville coal* has been hardly anywhere deposited in Mercer county; and that the numerous mines upon the bed so called are all or most of them working in the *Clarion coal* proper.

The third uncertainty to which attention must be called is of a more general systematic importance, since it refers to the place of the *Sharon Group* in the column of formations.

That the *Sharon Coal* lies beneath the Conglomerate Formation No. XII, of the Pennsylvania system, no one can now doubt; but whether it lies above or beneath the *Mountain Limestone*, which is a member of the Mauch Chunk Red Shale Formation No. XI, remains to be determined.

Prof. White, after stating the arguments in favor of the latter view in a special place in this report (Chapter VII) has desired to have the chapter canceled, because no certain conclusion could be reached. But I prefer to let it stand as printed, because the statement of facts is a good one, showing what the question at issue really is; and geologists are referred for further light upon it to forthcoming reports on Armstrong, Clarion, Jefferson, Forest, Elk and McKean counties. It is possible that the thin limestone at Lowell on the State line may be a second and later deposit of Mountain limestone; or a deposit of comparatively limited extent.

J. P. Lesley.

Philadelphia, *Oct. 20, 1879.*

REPORT OF THE PROGRESS

OF THE

SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA,

IN

MERCER COUNTY.

BY I. C. WHITE.

PART I.

SUMMARY STATEMENT OF THE GEOLOGY OF THE DISTRICT.

CHAPTER I.

Area, Township divisions; Levels above tide; Topography of the surface; River drainage; Character of soil, and Railway communications.

§ 1. Mercer county borders on the Ohio State line, next north of Lawrence county, and south of Crawford. Venango bounds it on the east, and Butler on the south east.

Its shape is nearly rectangular, with the longer sides running east and west, and the shorter sides north and south:* and it is said to have an area of 624 square miles.

Its townships are arranged in the following order:

Greene, Sugar Grove, Salem, Sandy Creek, Deer Creek, French Creek.

*The Ohio State Line, where originally run, was supposed to be part of a meridian of the earth, 3° 03′ W. of the meridian of Washington. But the recently proved inaccuracies of the boundary lines between the States of New Jersey and New York, and between the States of Pennsylvania and New York, throw serious doubts upon the accuracy of this boundary line between the States of Pennsylvania and Ohio.

W. Salem, Hempfield, Otter Creek, Perry, New Vernon. Mill Creek.
Pymatuning. Delaware. Fairview. Lake. Sandy Lake.
Hickory. { Jefferson. Cool Spring. Jackson. Worth.
{ West Lackawannock. East Lackawannock. } Findley. Wolf Creek.
Shenango. Wilmington. Springfield. { Pine. Liberty.

Levels above Tide.

§ 2. At Sharon, on the Shenango river, near the west line of the county, RR. grade is only 853′.

At Shenango, in the same valley, in the north west part of the county, RR. grade is 941′; at Jamestown, on the north county line, 979′; and at Salem, on the east branch, 998′.

At Mercer, the county town, on the Neshannock creek, the Railway Depot track lies at an elevation of 1097 feet above tide.

The RR. summit between Mercer and Shenango is 1177′.

The RR. summit near (W. of) Stoneboro' is 1199′.

The RR. summit on the Butler county line is 1340′.

The RR. summit between Mercer and Stoneboro' is 1388′.

It will thus be seen that the highest hill tops of Mercer county cannot be accounted more than, if they reach, 1500 feet above the sea, and that the two principal valley beds, as they issue from the county southward, stand at 800′ and 900′, respectively.

The Shenango valley bed falls 150′ in crossing the county from Jamestown on the north line to Pulaski on the south line; but the Neshannock heads in the county at full 1300′, and has a fall of over 400′ to Wilmington, where it enters Lawrence county.

The following tide altitudes of stations on railroads in the county are extracted from Report of Progress N, 1878.

Table 191. Erie and Pittsburgh RR.

	Miles.	*Feet.*
Summit Station, in Crawford county,	59	1141
[Highest point of RR. near this is 573′ above Lake Erie.]		[1146]
Linesville, in Crawford county,	55	1033
Espyville, in Crawford county,	51	1088
Kasson's, in Crawford county,	49	1111

Jamestown, crossing of Franklin Division of the Lake Shore and Michigan Central RR. just south of the Mercer county line,	42	979
Greenville Station, in Mercer county,	35.5	961
Shenango Station, in Mercer county,	34	941
Crossing of the Atlantic and Great Western RR.,	33	930
Transfer Station in Mercer county,	30	990
Clarksville Station, in Mercer county,	27	894
Sharpsville Station, in Mercer county,	24	948
Sharon Station, in Mercer county,	21	853
Wheatland Station, in Mercer county,	18	841
Middlesex Station, in Mercer county,	15	833
Pulaski Station, in Lawrence county,	11	826
Nashua Station, in Lawrence county,	—	821
Harbour Bridge Station, in Lawrence county,	4	816
Newcastle Station, at junction with Newcastle branch of the Fort Wayne and Chicago RR.	0	809
Rochester Station, in Beaver county, on the Ohio river,	—	710

Table 196. Atlantic and Great Western RR.

	Miles.	*Feet.*
Meadville Station, in Crawford county,	102	1080
Geneva Station, in Crawford county,	110	1069
Evansburg Station, in Crawford county,	116	1284
Adamsville Station, in Crawford County,	121	1148
Sugar Grove Station, in Mercer county,	—	1040
Greenville Station, in Mercer county,	129	984
Shenango, at grade crossing of the Shenango and Allegheny RR. in Mercer county,	—	936
Crossing of the Erie and Pittsburg RR.	—	936
Transfer Station, in Mercer county,	135	993
Crawford's, head-block of switch, (no station,)	—	893
Orangeville Station, in Mercer county,	141	945
Ohio State line, west line of Mercer county,	—	945
Burghill Station, in Ohio,	145	1044
Johnson's Summit, in Ohio,	—	1126
Baconsburg Station, in Ohio,	—	999
Warren Station, in Ohio,	162	900
Leavittsburg Station, in Ohio,	165	895
At crossing of main line and Mahoning division,	—	907

Table 192. Shenango and Allegheny RR.

Greenville Station, junction in Mercer county,	33.	961
Shenango Station, in Mercer county,	31	937

New Hamburg Station, in Mercer county,	26	1158
Freedonia Station, in Mercer county,	23	1177
Cool Spring Station, in Mercer county,	20	1127
Mercer Station, in Mercer county,	16	1108
Pardoe Station, in Mercer county,	11	1205
Pinegrove Station, in Mercer county,	6	1250
Harrisville Station, in Butler county,	0	1340

Table 193. Franklin Division of the Lake Shore and Michigan Central RR.

Franklin Station, in Venango county,	8	1017
Midway between stations, in Venango county,	—	996
Summit Station, in Venango county,	—	1165
Polk Station, in Venango county,	17	1084
Raymilton Station, in Venango county,	21	1138
Midway between stations,	—	1174
Naples Station, in Mercer county,	—	1165
Stoneboro' Station, in Mercer county,	29	1171
Coal Branch Station, in Mercer county,	—	1199
Clark's Station, in Mercer county,	—	1164
Hadley's Station, in Mercer county,	38	1070
Salem Station, in Mercer county,	43	998
Crossing of the Atlantic and South-Western RR. near Salem,	—	987
Midway between stations,	—	1083
Jamestown Station, crossing of Erie and Pittsburgh RR.	50	990
Turner Station, in Crawford county,	—	1060
Simond's Station, in Crawford county,	56	1057
Andover Station, in Ohio,	62	1095
Richmond Station, in Ohio,	—	1114
Dorsett Station, in Ohio,	—	988
Jefferson Station, in Ohio,	75	941
Ashtabula, main line L. S. & M. S. RR.	—	648
Lake Erie water level, at Cleveland,	—	573

Table 197. Mahoning Division of the Atlantic and Great Western RR.

Sharon Station, in Mercer county,	0.	859
Ohio State line, west line of Mercer county,	—	852
Hubbard Station, in Ohio,	7	937
Doughter's " "	—	973
Thorn Hill, " "	—	869
Youngstown " "	15	863
Briar Hill " "	—	880
Girard " "	—	865

Niles Junction with Niles and N. Lisbon RR.	23	890
Warren Station, in Ohio,	28	883
Leavittsburg Station, in Ohio,	31	895
Crossing of Atlantic and Great Western RR.	—	907
Lake Erie water level, at Cleveland,	80	573

Table 199. Sharon Branch.

Sharon Station,	859
Junction with main line of Atlantic and Great Western RR., near Sharon,	947

Table 190. Newcastle and Franklin RR.

Stoneboro' Junction with Franklin Division of the Lake Shore and Michigan Central RR.	36	1171
Coal Branch crossing, in Mercer county,	—	1194
Coulson Station, in Mercer county,	35	1277
Summit " "	32	1388
Gawin " "	30	1327
Jackson Centre, "	28	1257
Turner's Station, "	25	1137
Crossing of Shenango and Allegheny RR.	23	1112
Mercer Station, " "	22	1097
Hope Mills " " "	—	1107
Nelson " " "	15	1060
Leesburg " " "	16	1045
Volante Station, in Lawrence county,	13	1025
Neshannock Falls, " "	10	992
Wilmington, " "	9	928
Graham's, " "	7	907
Eastbrook, " "	5	906
Newcastle Junction with Newcastle and Beaver Valley RR., half a mile south of Newcastle,	0	793

Table 189. From W. S. Darley's Levels.

Hottenbrogh lower vein, in Lawrence county,	1093
Sandy Lake upper vein, in Mercer county,	1313
Sandy Lake lower vein, in Mercer county,	1113
Harrisville coal, in Butler county,	1379
Mercer,	1073

Topography of the surface.

§ 3. The topography of Mercer county is in marked contrast to that of Beaver and southern Lawrence, where the hills and valleys have been sculptured solely by the agencies now operative; whereas, here in Mercer, another agent of erosion, glacial ice, has once covered the entire county, and to a great extent modified the features of previous aqueous erosion.

In Beaver county, for instance, where the general surface seems never to have been interfered with by glacial ice, the streams are seen flowing in narrow, tortuous valleys, with very steep and rocky walls on each side, while the hills rise high above them in narrow hog-back ridges, or isolated conical peaks. Here in Mercer county, on the contrary, all those ridges and peaks which had been formed by preglacial erosion are seen to have been subsequently planed down to a general common level by the ice; and a much greater uniformity in all the upland surface was the consequence.

The valleys of the principal streams seem also to have been in some measure widened and straightened by the same agency. For, while the actual bed of a stream, such as the Shenango, may have numerous windings, the bed of the wide valley in which the stream meanders is remarkably straight.

The bounding walls, also, with few exceptions, are not steep and bluff-like, but slope gradually upwards, and their irregularities are of such a kind as to indicate that the slopes have been plowed down and ground off. Many exceptions to this of course occur, where streams have abandoned their old channels and cut new ones since the glacial epoch; and also where side streams have removed the glacial débris, and cut their way down into the solid underlying strata.

The river drainage.

§ 4. *The drainage system* of the county is quite complicated; but the rain-water all finds its way eventually into

the Beaver river, except that which falls upon the four north-eastern townships; this passes out eastward into the Allegheny river.

The "divide" which separates these two river systems crosses the county in a direction nearly north-west and south-east; or roughly speaking, parallel to the general course of Sandy creek. At the head of the Little Shenango a glacial stream has crossed and cut down through the barrier, leaving it so low that nothing except a careful instrumental survey can determine where the actual divide is between the waters which flow south-west into the Shenango and those which flow south-east by way of Sandy lake and Sandy creek into the Allegheny river.

The Shenango river is the principal stream of the county, and drains the entire western half of it. It enters Mercer from Crawford county about four miles east from the State line, and continues on a little east of south as far as the northern line of Pymatuning township. Here it turns and runs away to the eastward, bends south and returns on a nearly parallel course towards the west, forming what is called the Big Bend.* Continuing still to flow in a general westward direction until it touches the Ohio State line below Sharon, it again veers round to the south and south-east, and passes out of the county about as far from its western boundary as where it entered the county from the north.

The Shenango receives only two tributaries of any considerable size, Crooked creek and the Pymatuning.

Crooked creek enters the Shenango from the east at Greenville, and itself drains little of Mercer county, for most of its course lies in Crawford; but its principal tributary, the Little Shenango, drains a large territory in the northern portion of the county.

* Where the Shenango makes its great bend there is, I think, considerable evidence going to show that this portion of its course, or what constitutes the bend, has been cut out since glacial times; for the steep slopes of the hills along this part of the stream are singularly destitute of drift, and then there is an old valley extending from where the Shenango veers off to the east, south-westerly, along the line of the E. and P. RR., and intersecting the present channel of the stream again near the mouth of Pymatuming creek.

The Little Shenango differs from all the other streams of Mercer county in that it flows north-westward; while all the rest that are of any size flow in the general direction of drainage, southward. For several miles near its source it flows, or rather oozes, through a dismal swamp, whose aspect is so forbidding that its exploration has never been attempted.*

Pymatuning creek is a large and sluggish stream, rising in Ohio, entering Mercer county at Orangeville, and emptying into the right bank of the Shenango near Clarksville station. It flows in an old drift-filled valley, immense piles of which are often seen where subsequent erosion has taken place.

Neshannock creek drains the central portion of the county. It is formed by the union of Otter and Big Mill creeks at Mercer.

Otter creek heads up against the Little Shenango, north from the center of the county, and flows nearly south, carrying a large amount of water in its bed.

Big Mill creek heads up against the Allegheny river water-shed, and flows south-west, receiving as tributaries Little Mill and Cool Spring creeks.

The Neshannock carries the combined waters southward, and passes out of the county near the center of its southern boundary, receiving no tributaries of any importance except Pine, Dennison, and Campbell's runs.

The Little Neshannock heads on the Big Bend divide; flows nearly south through a wide drift-filled valley; receives its west branch just before leaving the county, and falls into the Neshannock a short distance south of the county line. Its west branch drains the eastern portion of Hickory township.

Wolf creek drains the south-eastern portion of the county, and is a bold and rapid stream, heading on the Allegheny river divide, and flowing south into Butler county to unite with Slippery Rock creek, and so into the Connoquenessing creek, and Beaver river.

* For the significance of these facts see under Drift, § 7, below.

Sandy and French creeks drain the north-eastern portion of the county, eastward.

Sandy creek enters Mercer from Crawford county; flows south-east, almost parallel to the Allegheny river watershed, and very close to it; and joins the Allegheny river in Venango county. The upper portion of the stream is so sluggish that its motion can scarcely be detected by the eye; but in the lower half of its course the fall becomes quite rapid.

Sandy Lake, with its short outlet into Sandy creek, is an elliptical body of water, a mile long by half a mile wide, lying partly in Lake and partly in Sandy Lake townships. Its depth is variously estimated at from 20 to 30 feet. The little stream which feeds it issues from the same dark morass in which the Little Shenango, flowing in an opposite direction, takes its rise, and it is impossible to tell when the divide is reached. The lake itself is almost surrounded by very steep sandstone slopes belonging to the Conglomerate series; and its basin was probably excavated by the glacial river which once moved south-eastward up the valley of the Little Shenango, and down the valley of Sandy creek to the Allegheny.

French creek, one of the main tributaries of the Allegheny river, passes across the north-eastern corner of the county on its way to Franklin, and so drains only an insignificant area of Mercer county.

Swamps.—Owing to the general flatness of the surface, left by the extensive glaciation to which the county has been subjected, many portions of it are now suffering from a lack of drainage. About the sources and often along the courses of streams occur extensive swamps. The largest of these are Pine and Half Moon swamps.

Half Moon swamp occupies the summit of the divide between Otter creek and the Little Shenango, a portion of its waters going in each direction.

Pine swamp lies near the south-eastern corner of Mercer, and extends east into Butler county.

Bogs frequently stretch for miles along both sides of the smaller tributary streams with a breadth varying from 50

to 200 yards, and with a characteristic vegetation of Tamarack, Black Alder, Poison Sumach, and Witch Hazel.

Soils.

§ 5. From what has been previously stated, it will be seen that nearly all the soils of the county have been derived from the decomposition of the Drift, since but a small portion of the surface is not covered with glacial débris.

As a general rule, the Drift makes a strong soil, well adapted for the growth of cereals; but, owing to the impervious clay which so often forms part of the Drift formation, much of the land surface has to be under-drained to make it productive. Many of the farmers resort to this method, and are reclaiming large areas of swamp lands which were formerly considered useless, but which, when thoroughly drained, are the most valuable in the county, since they yield a soil of rich black loam to a depth of two feet or more.

The principal productions are wheat, oats, and corn.

Grazing and dairying are also carried on to a considerable extent.

Railroad communications.

§ 6. The county is well supplied with commercial avenues.

The Erie and Pittsburgh RR. passes through the western townships, affording easy access both to Pittsburgh southward, and to the lakes northward.

The Atlantic and Great Western RR. passes across the north-western corner of the county. Its two branches, called the Sharon branch and the Mahoning branch, open up the Mercer iron region to the eastern and western markets.

The Franklin branch of the Lake Shore and Michigan RR. crosses the county from north-west to south-east, in the valleys of the Little Shenango and Sandy Creek.

The Shenango and Allegheny RR. leaves the Atlantic

and Great Western Railroad at Shenango Station, and runs south-east into the center of the coal and oil fields of northern Butler.

The New Castle and Franklin RR. connects the Franklin branch of the Lake Shore RR. at Stoneboro' Station, with the Erie and Pittsburgh RR. at New Castle.

The Sharpsville and Greenfield RR. (to be continued southward to connect with the New Castle and Franklin RR.) reaches the coal fields of Hickory township.

The now abandoned Beaver and Erie canal followed the banks of the Shenango to the mouth of Crooked creek, and then took to the latter stream; but its course is now only marked by pools of stagnant water, from which exhale the germs of malarial fever.

Many people living alongside of this old canal suffer from chills and fever all their lives without attempting to remove the cause; yet this could often be affected in a few hours by merely draining off a neighboring pond.

One of these fertile sources of disease and death is found within the borough limits of Sharon, the largest and most enterprising town in the county. So far as I could learn, no efforts have ever been made to abate the nuisance, although the inhabitants are constantly suffering in health from its presence. Most of them seem not to be aware that the proximity of a pool of stagnant water is detrimental to health, and many of them often expend hundreds of dollars in doctor's fees when but a fraction of the amount spent in draining their surroundings would bring them health and happiness.

Chapter II.

Surface geology; Drift; Erratic bowlders; Terraces; Buried valleys.

§ 7. Drift.—Whatever doubt might be felt about the former presence of the Northern Ice in Lawrence and Beaver counties, there can be none with regard to Mercer; for the glacier has left its unmistakable impress upon

hundreds of exposed rocks in almost every portion of the county.

Wherever the hard rocks of the conglomerate series have been uncovered they are found to be smoothed and scored and grooved by ice. There seems to have been no points too elevated for the ice to reach. On the very summit of Keel Ridge, 1250 feet above tide, the sandstone is marked by glacial scratches.

A great sheet of Drift moreover, often more than one hundred feet thick, covers almost the entire county.

Its composition is quite various. At times it is composed almost entirely of a bluish white clay, of impalpable fineness, with only here and there scattered through it a bowlder of rock. Again it seems to consist of cobble stones, piled together in immediate contact with one another, and varying in size from one inch up to huge masses several feet in diameter.

The bowlders found in the drift, most of them worn or rounded by attrition, consist of granite, gneiss, greenstone, and nearly all the varieties of crystalline rocks; but also of limestone, sandstone, shale, and even coal. Intermingled with all these there is usually an abundance of bluish white clay.

Bowlders of large size are often found in the Drift. Mr. Pierce states that in sinking Oakland shaft No. 1, a granite bowlder several feet in diameter was found imbedded in blue clay 60 feet below the surface.

Bowlder clay nearly always forms part of the general drift deposit. This clay often percolates downward through the subjacent Sharon shales and coats the Sharon coal, much to the injury of its appearance and reputation, but not in the least affecting its excellence as a fuel.

In the Stoneboro' district, and about a mile south-east of the village, the constitution of the Drift has been made known by three bore-holes, the records of which are as follows:—

Bore hole No. 1, at Stoneboro'. Fig. 1.

1. Surface débris, ... 20'

2. White sand,	15′
3. Cobble stones,	10′
4. Blue clay,	13′
	58′

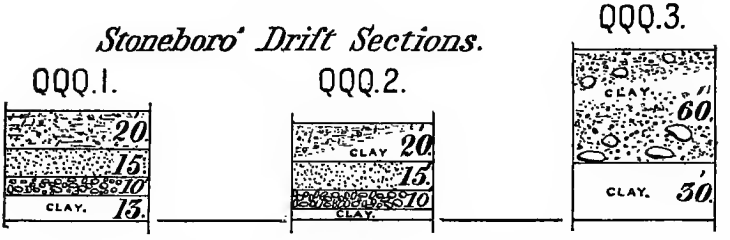
Bore hole No. 2, at Stoneboro'. Fig. 2.

1. Surface débris and clay,	20′
2. White sand,	15′
3. Cobble stones,	10′
4. Yellow clay,	6
	51′

Bore hole No. 3, at Stoneboro'. Fig. 3.

1. Clay, sand, gravel, and bowlders intermingled,	60′
2. Blue clay,	30′
	90′

Stoneboro' Drift Sections.



The thickness of the Drift is great in some localities. At the Five Points coal works, (Oakland Shaft No. 2,) for instance, 110 feet of it was passed through before rock was reached.

The excavating energy of ice has been doubted. My explorations in Hickory township, of this county, brought to light one case at least in which it seems to me impossible to doubt that a great thickness of rock has been cut out by a moving glacier. The case is as follows:

In working the Sharon coal at Oakland Shaft No. 1, in the central portion of Hickory township, the coal bed suddenly disappeared, abutting against a bluish-white clay holding an occasional boulder. The proprietor, Mr. Pierce, drove on 100 yards through this Drift clay, and found his coal bed on the other side. No explorations were made to

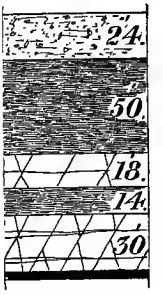
find the bottom of the clay which filled this cut-out. But, at another point, Mr. Wise drilled to a depth of 40 feet below the level of the Sharon coal bed without reaching the bottom of the clay.

The rocks here cut away are pierced by the Oakland Shaft No. 3, a few rods west from the cut-out. See Fig. 4, (100′ : 1″.)

Oakland Shaft, No. 3.

1. Drift,	24′	
2. Slate, gray,	50′	
3. Sandstone, very hard,	18′	140′
4. Slate, gray,	14′	
5. Sandstone,	30′	
6. *Sharon Coal*,	4	

QQQ.4.



All this 140 feet of rock has been excavated in a narrow channel. Wise's boring extended down 40 feet further, making at least 180 feet of excavation.

The Oakland company sunk several shafts along this old ice channel, and in their mining operations have traced it nearly a mile, on a course about south 30° east (magnetic,) widening from 100 yards at Oakland No. 1, to 400 yards at the Five Points coal works, Oakland No. 2.

It might be objected that this drift-filled channel may have been cut by some stream, perhaps the Shenango, which in past time might have held a course through this region, instead of flowing, as it now does, further to the west. But the topography of the country opposes such a supposition. All along the present channel of the Shenango we find an unbroken series of rock strata far above the level of the depth to which this channel has been explored.

How far it may extend south-eastward is not known, but as it has never been struck by any of the borings in the vicinity of Bethel (near to which village its known course

would carry it) the cut-out doubtless does not extend much to the south of Oakland No. 2.

The valley in which the Little Shenango river flows northwestward, and Sandy creek flows south-eastward, both draining a common swamp, seems to me another case of glacial erosion.

At no point of its course is the bed of this valley less than 200 feet below its bordering hilltops. The divide is insensible; the swamp three or four miles long, and 200 feet below its bounding walls. There is nothing to prove that the Little Shenango ever occupied the whole length of the valley, and flowed into the Allegheny river; and the exposed rock surfaces all along the valley are scratched in the direction of its length. It has certainly been the bed of a glacier moving towards the south-east. Whether it has been wholly excavated by the glacier, or was wholly or partly excavated previously by a river once flowing from the Allegheny Valley country into Lake Erie, is the only open question.*

Erratic Bowlders.

§ 8. This class of rocks has been fully described in the Reports on Beaver and Lawrence counties, and the same facts there stated would apply with greater force to the bowlders in Mercer, which seem to cover the whole county like the Drift. Many of them are large. I have encountered some with a diameter of ten feet. Most of them are of granite and gneiss; many of sandstone; all of them transported from a distance.

New facts, however, were learned respecting their distribution.

In Beaver and Lawrence they always seemed to lie on the surface of the true Drift. They were never seen commingled with it under circumstances plainly suggestive of secondary transportation.

I stated on page 9 of QQ that this negative evidence is

*See Mr. Carll's discussion of the ancient drainage of Western Pennsylvania into Lake Erie, in Report of Progress I.I.I.

of little importance in determining their relations to the Drift, there in Lawrence county, because of a paucity of exposures exhibiting the constitution of the Drift. But here in Mercer county a great many shafts have been sunk to the *Sharon coal*, through from 50′ to 100′ of Drift; and Mr. Walter Pierce, of Sharpsville, tells me that he seldom sinks a shaft without encountering one or more bowlders as large as those usually seen on the surface. In Oakland No. 1, at a depth of 60 feet, a bowlder of granite was found six feet in diameter. The larger class of bowlders are therefore not confined to the surface of the Drift, as appearances suggested in Lawrence.

Seeing then that the same kind of large rocks are found not only on the upper surface of the Drift, but also in the body of the formation, the question of their transportation presents itself in a new and different shape.

The theory adhered to in Q and QQ is that of Dr. Newberry, who has assigned their transportation to icebergs during a period of continental submergence subsequent to the Glacial epoch.

But it was always a mystery to me why, on this view of the matter, their distribution should be confined so closely to that of the Drift; for, with very few exceptions, I have never found them more than two or three miles south of the southern limit of the Drift. For instance, not a single bowlder in Pennsylvania occurs south from the Ohio river. But, ten miles north of the river they cover the surface like flocks of sheep, and that on hills of higher elevation. Now as the topography, as we at present see it, could not have interfered with the southward progress of icebergs, it seems strange that they should all have been of such uniform size as to melt away entirely at a fixed limit toward the south. This would seem to be out of consonance with what is known of the transportation of icebergs in modern seas.

It is true that such bowlders are to be found on the highlands of Beaver county a few miles (five or six) further south than the finer drift material has been observed; but it is very possible that erosion may have so disturbed and removed the finer material of the Drift that it has nearly

or quite disappeared from the sloping sides of the highlands.

Moreover, I am now convinced that the great gravel beds found along the valley of the Little Beaver, in Beaver county, are true Drift deposits; and that their transportation to their present positions was not effected by the streams, as erroneously stated in Q.

It is then a certainty that true Drift deposits extended as far south as Homewood in Beaver county, even over the highlands; for only two miles west from Homewood is seen a great gravel bed 60 feet thick, consisting of true Drift material. "*Erratics*" on the highlands are not to be found more than five miles south of this; although in the valleys of the streams they occur quite to the Ohio river.

When it is considered then that rocks precisely similar in size and composition to the so-called erratics are found in Mercer county imbedded at all depths in the finer materials of the true Drift, and that their geographical distribution is almost exactly confined to the drift-covered area, it is difficult to resist the conclusion that both the erratic blocks and the finer drift owe their transportation to the same agent, whatever that might have been; whether icebergs, or more probably moving glaciers.

The predominance of the larger bowlders on the surface admits of ready explanation on the hypothesis of glacial transportation; for, a considerable thickness of the finer material of the Drift must have been removed by erosion from every part of the region during ages of exposure to atmospheric influences. The larger blocks, resisting decay, would tend to accumulate on the surface; and their great numbers merely indicate how many of them were imbedded in the vertical thickness of drift removed.*

Terraces.

§ 9. Terraces are found along most of the principal

* [The accumulation of masses of quartz on some of the mouldered slate slopes of York county, and of blocks of titaniferous iron ore on the lowered surfaces north of Greensborough, in North Carolina, illustrate the correctness of the author's views.—J. P. L.]

streams, but they do not possess the regularity of height, nor the extent of the Beaver and Lawrence county terraces.

Their succession is best seen along the Shenango. Ascending from the bed of the stream, we often meet with broad level stretches, at heights of 10′ to 30′, 60′ to 80′, and 100′ to 125′; corresponding, in a rough way, to the three terraces seen at New Castle and near New Brighton, on the Beaver.

The *first terrace* is well seen at Clarkesville, stretching back between the Shenango and Pymatuning creeks over a wide and almost level area.

The *second terrace* makes another level, at the height of 60 feet above the stream, stretching back northwest from Clarksville. It has not the width of either the first or third, being a good deal eroded.

The *third terrace* is seen at Sharpsville, on a level with the Erie and Pittsburgh Railroad, (100 feet above the level of the Shenango); and again as a broad plateau stretching southward toward Sharon, sometimes at a height of 125 feet above the Shenango.

At Sharpsville Mr. Kitch dug a well in this terrace through alternations of sand, clay, and cobble stones, with an occasional large rounded granite bowlder, for 63 feet, without reaching its base.

Along the Neshannock none of the terraces are often seen except the *first*, for the hillsides are quite steep, and the two upper terraces have probably disappeared by erosion, if they were ever present.

Along the Pymatuning the *first* and *second* terraces are generally present, although the latter has been to a considerable extent worn away and made irregular in height.

Buried Valleys.

§ 10. The principal streams of the county, such as the Shenango, Pymatuning, and Sandy creeks, do not flow over rock bottoms, but over deposits of silt and cobble stones, extending down to more than 700 feet below the present water beds. At least this is the case with the Shenango and the Pymatuning.

No borings or explorations have been made *in the center* of the old valley of the Shenango, so that *the maximum* depth of its excavation cannot be stated.

An old boring near Sharon Furnace, half a mile east of the present water course, reached mother rock at 45 feet, but on the side slope of the ancient valley. A boring at Newcastle, 22 miles down the river, went through 135 feet of filling.

The ancient valley bed of the Pymatuning was found to be more than 100 feet beneath the Tamarack Swamp, just above the mouth of the creek, or more than 80 feet beneath the water bed of the present stream. After a large amount of earth and timber for the fill of the Sharon Branch railroad had been sunk in the swamp, the chief engineer, Mr. Chas. Latimer, resorted to spliced piles, driven to a depth of 100 feet, on which he placed the road bed, supposing that the piles had touched rock. But they have subsequently sunk still further, and the depth of the swamp deposit is still unknown.

Another buried valley extends from Clarksville Station to Shenango Station, along the line of the Erie and Pittsburgh railroad. Its present surface is bounded by hill slopes 200 feet high, and where the present surface is highest Mr. Pauley bored for water 63 feet through silt without striking bed rock. It looks as if the Shenango once flowed through this buried valley, and that after it had been choked with Drift, had abandoned it too for its present circuitous course round the Big Bend. The probability of the *post glacial* age of the present roundabout valley is heightened by the fact that it is singularly free from Drift deposits.

Another buried valley is one through which the upper part of the Neshannock flows, if it be correctly reported that a bore-hole near Leesburg station, on the Newcastle and Franklin railroad, went down through sand and loose material 80 feet below the present water level.

The buried valley of the Little Shenango, from Greenville through to the Allegheny river, has already been described. It is filled with Drift from end to end, but no

borings have been made in it, and we cannot tell whether its buried rock-bed slopes as a whole continuously southeastward towards the Allegheny river, or northwestward toward the Shenango river and Lake Erie.

The Drift-filled valley-beds of Sandy creek and Crooked creek are equally unexplored.

The buried valleys of Mercer county are continuations of the buried valley of the Beaver, in Beaver and Lawrence counties, discussed in my Report QQ, pages 12 to 20, and my observations in Mercer county have strengthened my belief in the views there expressed.

Chapter III.

The Stratified rocks of Mercer County.

§ 11. The rocks of Mercer county lie almost horizontal, the strike being east and west, and the dip towards the south, at a rate varying between 12 and 15 feet to the mile.*

No regular anticlinals or synclinals traverse this county; but numerous local rolls give slight reverse north dips here and there, which extend no great distance. Therefore, the highest rocks in the geological series are on the ridges in the southern townships. Going northward, towards Crawford county, is equivalent to descending in the geological series.

Passing from Lawrence northward into Mercer county, or from Mercer northward into Crawford county, is equivalent to passing from higher to lower rocks in the coal series.

The Lower Productive Coal measures (Kittanning and Clarion groups) occupy the highlands in the south-east part of the county.

The Conglomerate measures occupy the greater part of the central uplands of the county; but their bottom layers shoot over the hilltops near the Crawford county line.

The Sub-Conglomerate measures are exposed only along the principal streams. The Shenango cuts deeply into them all across the county; Little Shenango and Sandy creeks not so deep; and the Neshannock merely into their top layers.

[* J. T. Hodge calculated the average dip from Lake Erie to Franklin to be *one seventh of one degree.*—J. P. L.]

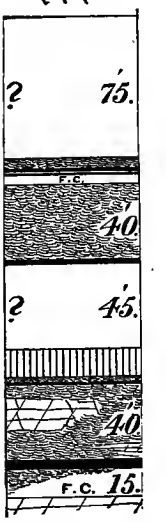
Chapter IV.

The Lower Productive Coal Measures.

§ 12. The following section (Fig. 5) compiled along Wolf creek exhibits all of these measures that remain in the southeastern part of Mercer county:

Wolf Creek Section (Compiled).

Lower Productive Coal Measures.	Kittanning Group.	1.	Concealed, from hill top,	75′
		2.	Shales, dark,	5′
		3.	*Darlington Coal,* Coal, 1′ 0″; Slate, 2″ to 2″; Coal, 2′ 0″	3′ 2″
		4.	Fireclay,	5′
		5.	Shales, sandy,	40′
		6.	*Kittanning Coal,*	2′
		7.	Concealed,	45′
	Clarion Group.	8.	Ferriferous Limestone,	15′
		9.	Shales,	3′
		10.	*Scrub Grass Coal,*	1′
		11.	Shales and sandstone,	25 to 40′
		12.	*Brookville Coal,*	4′ 8″
		13.	Fireclay and sandy shales,	5 to 15′
		14.	*Homewood Sandstone.*	
				253′ 10″



It will be seen from this section that no coal bed higher than the *Darlington* remains in Mercer county.

Foster's high knob, half a mile south of the village of N. Liberty, near the southeast corner of the county, rises indeed 80 feet above the *Darlington* and should therefore take in the *Freeport Lower Coal.* But here as elsewhere the Drift is from 30 to 50 feet deep, and the knob contains only the bottom layers of the *Freeport Lower Sandstone.*

§ 13. The *Darlington Coal,** so important in Lawrence county, occupies only a few isolated hill tops along the

southern borders of Mercer; and has been mined at only two localities.

At Foster's Bank, just south of N. Liberty, it shows the slate parting which splits it into two benches everywhere in Lawrence and Beaver counties, but nearer the bottom; here the parting is nearer the top. The coal is excellent.

In H. M. George's high knob, half a mile east of N. Liberty, a shaft of 25′ depth strikes the bed, parted as at Foster's, but very poor, slaty and pyritous.

Both areas combined do not exceed 50 acres.

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§ 14. The *Darlington Underclay* and *Shales* are nowhere well exposed. In Mr. George's well they proved to be of a dark slaty color, and charged with ore balls. Foster's drain cut 15 feet of fireclay and sandy shales.

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§ 15. The *Kittanning Coal*† underlies of course a larger area than the Darlington (40′ to 50′ above it;) being found in a few high Knobs in Liberty, and one in Wolf Creek township; but it has never been mined; although it might possibly be worth mining were entries pushed far enough to get under good roof; for it yields good coal sometimes in Lawrence county.

Four or five hundred acres are underlaid by it near N. Liberty. Mr. George reports that it is a common thing for wells to pass through it, finding 20″ to 25″ of coal. Its blossom may be seen along the roadside on D. F. Courtney's

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[*The thin coal bed found occasionally, in Lawrence and Beaver counties, 25′ to 40′ above the Darlington, (See Report Q, pp. 249, 253, 265, &c.; Cannel coal opposite Beaver Falls, Q, 202; Eichenhaur's local 8 foot coal and slate bed on the Little Connoquenessing, &c) seemed too sporadic and irregular to deserve a name. But it now appears to represent the persistent *Kittanning Upper Coal* of Mr. Chance's Report V, on N. Butler, and of Mr. W. G. Platt's Reports H^3 on Indiana, and H^4 on Armstrong. The *Darlington Coal* then, becomes their *Kittanning Middle;* and the *Kittanning*, their *Kittanning Lower Coal.*—J. P. L.]

[† Chance's and Platt's *Kittanning Lower Coal*?—J. P. L.]

land. Here it was once opened at the outcrop, 2 feet thick, too slaty and rotten to mine; it might be better further in. In Brannaman's cellar, beyond Wolf creek, its outcrop was cut, 2 feet thick, and seemingly impure.

Here it lies 45′ above the *Ferriferous Limestone.*

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§ 16. *Kittanning Underclay and Shales.*—Whatever the character of these may be, I found no exposures of them anywhere north of the Mercer county line; but their outcrops are marked by gentle slopes.

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§ 17. *The Ferriferous Limestone.*—Areas of this important stratum have been preserved from erosion in four of the southern townships, as the blue line of its outcrop drawn upon the colored county map will show. One small area exists in Springfield near the county line. Some knobs in Pine, just east of Pinegrove, catch it. Some high land in Jackson, two miles south of Jackson Centre, takes it in. One very high knob at Hendersonville, in northern Worth, holds about an acre of it; and this is its most northerly *known* outlier. It occupies a few knobs along the northern border of Findley; and one solitary hill in the extreme northwest corner of Wolf Creek township.

In Liberty township it outcrops along both sides of Wolf Creek, forming long lines of cliffs over the steep hillsides which border the stream.

Besides the above mentioned, there are other areas high enough to contain this bed; but no limestone appears in them.

One of these barren areas occupies a long narrow strip of high land in Lackawannock, south of Greenfield, the top of which rises 160′ above the *Mercer Lower Limestone* (which lies seldom more than 125′ beneath the *Ferriferous.*) We must conclude then one of three things: Either 1, that the Drift is deep on this ridge; or 2, that the interval between the two limestones is here exceptionally large; or 3,

that the original deposit of the *Ferriferous limestone* in Mercer county was as irregular in extent and thickness as in Lawrence, Beaver and Butler counties.

Another piece of high-land barren of this limestone lies south of Pardoe in Findley township, where 116′ of ground overlies the *Pardoe Coal* (which along Wolf Creek and south of Jackson Centre underlies the *Ferriferous L.* never more and often less than 45′.) Mr. F. H. Oliphant informs me that he has bored several holes through 50′ to 60′ rocks over the coal and never seen a trace of the limestone.

Similar facts are reported of the numerous bore-holes of the Mercer I. & C. Co. in Lake, south of Stoneboro', going down through more than 50′ of rocks to the coal without finding a trace of limestone.

Boreland's high knob in New Vernon (one of the northern townships) rises 90′ above the *Brookville Coal*, and should take in the *Ferriferous Limestone*. Probably the knob is of Drift.

A very high knob in French Creek township, and near the Crawford line, rises nearly 200′ above the *Mercer Coals*. Search should be made for the limestone in this deeply Drift-covered hill.

The *Ferriferous Limestone*, wherever it appears in Mercer, exhibits the same physical aspect as in Lawrence county.

The upper part is of a light ashen gray color, glistening with calcite.

The lower part, 3′ to 4′ thick, is of a dark blue color.

Both upper and lower benches are richly fossiliferous, with the same forms observed in Lawrence county, viz.:

Spirifer cameratus.
S. lineatus.
S. opimus.
Productus Nebrascensis.
P. longispinus.
P. semi-reticulatus.
P. Prattenanus.
Hemipronites crassus.
Chonetes mesoloba.
Euomphalus rugosus.
Pleurotomaria Grayvilliensis.
P. carbonaria.
P. turbinella.
Bellerophon carbonarius.
B. Montfortianus.
B. percarinatus.
B. Stevensanus.
Nucula ventricosa.
Nuculana bellistriata.
Macrocheilus primigenius.

Macrocheilus ventricosus.
Astartella concentrica.
Polyphemopsis peracuta.
Aviculopecten carbonarius.
A. Whiteii.
Athyris subtilita.
Solenomya radiata.
Macrodon obsoletus.
Aviculo-pinna Americana.
Nautilus occidentalis.
Platyceras tortum.
Synocladia biseriatis.
Lophophyllum proliferum.
Orthoceras cribrosum.
Archæocidaris Wortheni.
Pentremites pyriformis.
Zeacrinus mucrospinus.
Multitudes of *Crinoidal* fragments.

The lime made at George's quarry, on Wolf creek, is of excellent quality, not only for agriculture, but especially for plastering, and is hauled to points many miles distant.

At the quarries in Jackson township, from 9′ to 12′ of the bed remains, the top being planed off by the ice, and covered with Drift.

Along Wolf creek the whole bed remains, from 12′ to 15′ thick.

Black's, Buchanan's, McDougal's, and other quarries are a short distance east of Pinegrove.

John Henderson's old quarry, on the summit of the Hendersonville Knob, is ten miles distant from any other limestone exposure.

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§ 18. The interval between the *Ferriferous Limestone* and the underlying *Scrubgrass Coal*, varies from 1′ to 5′, thus: Black fossiliferous slate, 5′, at George's quarry, Liberty township; 1′, at T. Vernon's quarry, Jackson township; gray clay slate, 3′, at D. F. Courtney's quarry, Liberty township.

The *Scrubgrass Coal*, 8″ to 10″ thick, is found underlying every exposure of *Ferriferous* Limestone in Mercer county.

The coal, where stripped along Wolf creek at Brannaman's, was pure and good. At George's it is 8″ thick; at Vernon's only 6″ thick; at Courtney's 8″ thick.

§ 19. The interval between the *Scrubgrass Coal* and the next lower wrought *Coal* varies both in thickness and character.

At Courtney's, on Wolf creek, it is 39′, thus:

QQQ.6.

Fireclay,	4′
Sandstone, flaggy,	15′
Shales, dark, slaty, with iron ore,	20′

In Orr's shaft, southern edge of Springfield township, it is 27′; dark shales with ore balls.

In the numerous boreholes of the Mercer I. & C. Co., in Lake township, 25′ to 30′ of massive sandstone was often passed through.*

In Enfield's old shaft, near the south line of Lake, 44′ of gray sandy shale was found. A hole drilled near the shaft went through 25′ of massive sandstone, and then 45′ further down to the coal.†

The Pardoe boreholes and shafts have found nothing but 50′ of shales over the *Brookville Coal*, there mined, the *Clarion Coal* being apparently wanting.

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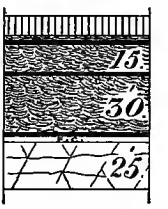
§ 20. The *Clarion Coal*, as recognized in Lawrence county, has never been seen in Mercer county.‡ And yet it is plainly exposed, varying from 1′ to 2′ in thickness, on Hettenbaugh run, (Scott township,) a few miles south of the Lawrence county line, as in the following compiled section:

Hettenbaugh Run Section.

QQQ.7.

Ferriferous Limestone,	10′	
Shales, blue,	3′	
Scrubgrass Coal,	2′	
Shales, grayish,	15′	
Clarion Coal,	1′ 6″	91′ 6′
Shales, sandy,	30′	
Brookville Coal,	2′	
Fireclay,	3′	
Homewood Sandstone,	25′	



* Probably this sandstone, mistaken for the Tionesta, deceived Prof. Rogers into calling the Stoneboro' coal the *Tionesta coal.*

† If this be the Kittanning Sandstone, then the (regularly underlying) *Ferriferous Limestone* is absent from this area.

‡ It is of course a *possibility* that the Pardoe coal is *Clarion* and not *Brookville.* But it is far more probable that the Clarion disappears northwards, or coalesces with the Scrubgrass.

Although 20′ is given as the interval between the Limestone and the Clarion Coal in the above compiled section, nevertheless this interval, when measured at different places along the run, varies between 10′ and 25′. Since the *Clarion Coal* in Lawrence county approaches within 10′ of the base of the Ferriferous Limestone, it may very easily in Mercer county coalesce with the included Scrubgrass Coal, as Mr. Chance has some reason to believe it does in the northern townships of Butler county. (See his Report V.)

On the other hand, since it runs down in thickness on Hettenbaugh run to 12 inches, there is no improbability in supposing that it thins to nothing across the Mercer county line.

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§ 21. The interval between the Ferriferous Limestone and *Brookville Coal* is only 27 feet* along the southern line of Springfield, and (beneath the Scrubgrass Coal) consists of shales. This interval increases to 40 and 45 feet along Wolf Creek; while 50 feet of shales (and nothing else) are seen in the numerous Pardoe shafts and boreholes.

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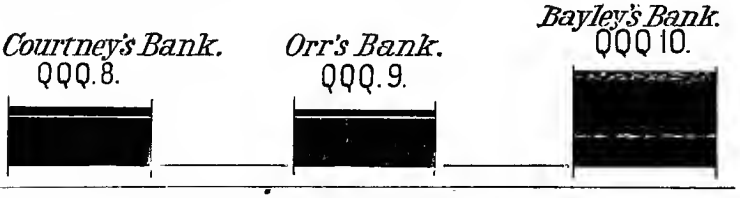
§ 22. The *Brookville Coal* is the most important and most widely extended coal bed in Mercer County, being generally mined in Findley, Jackson and Lake townships, where it lies almost directly upon the *Homewood Sandstone.* Along Wolf Creek it lies from 5′ to 10′ above the sandstone.

At Courtney's mine on Wolf Creek, and at Orr's mine, 4 miles further west, in Springfield township, the bed consists of two benches, with a thin parting of slate, thus:—



*I mistook this bed therefore on first entering Mercer County from the south for the Clarion coal.

		Courtney's, Fig. 8.	*Orr's, Fig. 9.*
Brookville	*Coal*,	0′ 6″	0′ 4′
	Slate,	1″ to 0′ 2″	1″ to 0′ 2″
	Coal,	2′ 6″	2′ 6″

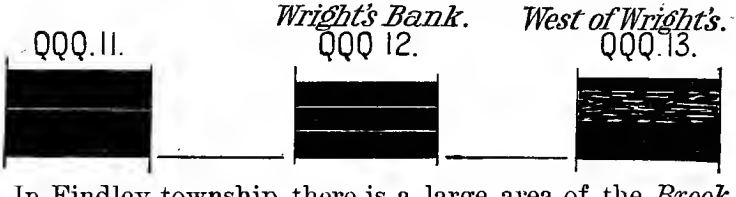
These are evidently on the same bed; although Courtney's is 40′ to 45′, and Orr's only 27′ below the *Ferriferous Limestone.*

But at Bailey's in the northwest corner of Sandy Lake township the bed has a very different structure, thus:—

		Bailey's, Fig. 10.	
Brookville	*Coal*, slaty,	6″	5′
	Coal, good,	2′ 6″	
	Coal, slaty,	0.5″	
	Coal.,	3″	
	Sulphur band,	3″	
	Coal,	1′ 6″	

At Dougherty's (&c.) in Pine, *Fig. 11*,—at Wright's half a mile west of Mercer, *Fig. 12*,—and at a mine west of Wright's, *Fig. 13*,—the bed is still further varied, thus:—

	Pine town. Fig. 11.	*Wright's, Fig. 12.*	*—— Fig. 13.*
Brookville,	*Coal*, 2′ 0″	Coal, 1′ 3″	Coal, 8″
	Slate, 1″ to 4″	Slate, 1″	
		Coal, 1′ 3″	Slate, 1′ 8″
	Coal, 2′ 4″	Slate, ½″	
		Coal, 1′ 4″	Coal, 1′ 11″
	4′ 5″	3′ 11½″	4′ 3′



In Findley township there is a large area of the *Brookville Coal*, long and extensively mined by the Mercer Mining and Manufacturing Company (F. H. Oliphant and others,) shipping 400 tons daily, northward and westward (by the Shenango and Allegheny Railroad,) solely for steam and grate purposes, the coal being sulphurous. The bed thickens to 5 feet and thins away to nothing in different places; and is much cut up by clay-veins and horse-backs. The mine-drains are often cut in the top layers of the *Homewood Sandstone.*

In Jackson township the *Brookville Coal* is mined extensively by the Jackson Coal Company, shipping 150 tons daily (by the Newcastle and Franklin Railroad,) principally for steam and grate use (being sulphurous.) The bed is about 4 feet thick but subject to such fluctuations as to thin down sometimes almost to nothing.

In Lake township, a large area of the *Brookville Coal* is mined, chiefly by the Mercer Iron and Coal Company, near Sandy Lake, shipping 100,000 tons annually (by the Jamestown and Franklin Railroad.) Although somewhat pyritous, it makes an excellent steam and stove coal. The bed varies between 3½ and 4½ feet.*

In Lake township, near the northeast corner, the Brookville Coal is mined on A. D. Lowry's land, 4′ 9″ thick, quite pure and highly esteemed by the blacksmiths. A sulphur-band parts it near the middle.

In Sandy Lake township, in the northwest corner, high land makes a considerable area of *Brookville Coal*, with no roof on it but the Drift deposits; consequently, in Bailey's mine, the 6-inch slaty coal at the top (see Fig. 10 above) is left for a roof. The coal throughout the bed is tolerably fair; but there is only about 6 inches of coal (in the bottom bench) fit for smithing.

In New Vernon township, far to the north, and within five miles of the Crawford county line, a high knob, on Boreland's and Voorhees' farms, catches a little patch of the *Brookville Coal*, so much eroded and Drift-covered that mining has not yet been successful.

In Worth township, northwestern part, near Hendersonville, a few isolated areas of *Brookville Coal* are left on Wheeler's, Burnett's, and other farms. The bed is 4 feet thick, and the coal good.

In Wolf Creek township Mr. Hume mines it.

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* Here the Geology of Pennsylvania, 1858, mistakes this coal for the bed *under* the *Homewood* (old Tionesta) *Sandstone*, and calls it the *Tionesta Coal*. The mistake was made by wrongly identifying the Clarion Sandstone, in the hill above it, with the *Homewood* Sandstone, which underlies it. It is undoubtedly the Pardoe (*Brookville*) Coal. The *Homewood Sandstone* and *Mercer Lower Limestone* may both be seen under it at Stoneboro'; the Limestone only 60′ to 70′ below it.

In Pine township a considerable area of *Brookville Coal* remains, and a little mining has been done, above Pine Grove village, on Dougherty's, McGoffin's, and other farms. For the character of the bed, see Fig. 11 above.

In E. Lack. township, 1½ miles west of Mercer, the *Brookville Coal* has been mined for fifty years, on Wright's land, at the summit of a high ridge, to supply the neighboring country. The bed is described in Fig. 12 above. The bottom bench only is mined for the blacksmiths, the rest of the bed is too sulphurous. The area is limited and must be nearly exhausted.

Further west, on the Mercer-Sharon road, the slate parting has become very thick, as shown in Fig. 13 above.

In Lackawannock township, still further west, a high north and south ridge, near Greenfield, should contain the *Brookville Coal*, which indeed seems to be indicated in holes bored here to find the Sharon block coal.

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§ 23. Under the *Brookville Coal* lie generally 5′ to 15′ of fireclay and sandy shales; and then the *Homewood Sandstone.*

South of Stoneboro', in the Mercer I. and C. Co.'s borings, only 2′ to 3′ of fireclay intervene.

I have never seen a trace of coal in this interval.

Mr. F. H. Oliphant, Jr., however, thinks he has seen a thin coal 10′ to 12′ below the Pardoe coal, and calls *it* the *Brookville* bed, and the Pardoe Coal the *Clarion.*

Mr. Berringer states that in draining his mine (1½ miles west of Mercer) he cut an 18″ coal, lying 15′ below his bed.

On Wolf Creek there is not a trace of any such coal although the exposures are fine; nor has any coal been pierced, in the numerous bore-holes, until after passing entirely through the *Homewood Sandstone* into the Mercer group below it.

Nor is any coal cut by the Pardoe drift, which starts in on top of the sandstone, and traverses the shales, until the dip brings down to its level the *Brookville* bed.

If there be coal in this interval, therefore, it must be in a few local deposits.

[In the absence of the Clarion bed, it remains an open question, whether such local deposits may not, after all, represent the northern edge of the Brookville Swamp grounds of the Coal age. J. P. L.]

Chapter V.

The Conglomerate measures.

§ 24. The top of this series, which form the surface rocks over the largest portion of Mercer county, is a sharply defined horizon, marked by the upper surface of the *Homewood Sandstone*, from 5 to 25 feet beneath the *Brookville Coal* bed. Its lower limit will be discussed further on, but may be provisionally assumed in the following *compiled section*, Fig. 14, as the undersurface of the *Sharon Conglomerate*:

Fig. 14. Compiled Section of No. XII.

Homewood Sandstone,		50′
Shales,	0′ to	10′
Iron ore,	0′ to	2
Mercer Upper Limestone,	0′ to	2′ 6″
Mercer Upper Coal,	0′ to	2′ 6″
Shales,		25′
Iron ore,	0′ to	2′
Mercer Lower Limestone,		2′ 6″
Shales,	0′ to	10′
Mercer Lower Coal,	0′ to	4′
Shales,		10′
Iron ore,	0′ to	1′
Shales,		5′
Connoquenessing Upper Sandstone,		40′
Shales and iron ore,		10′
Quakertown Coal,	0′ to	2′
Shales,		40
Connoquenessing Lower Sandstone,		30′
Sharon Iron Shales,		30′
Sharon Coal,	0′ to	4′
Fireclay and shales,		5′
Sharon Conglomerate,		20′
		307′ 6″

The thicknesses of some of the members of the series, as given above, are quite variable, and therefore the total by addition (307½′) does not represent the actual thickness of the series. But I obtained two direct measurements from top to bottom, which are reliable.

1. At Keel Ridge, in Hickory township, I found the interval between the top of the Homewood and the Sharon Coal to be 225′.

2. At the Cleveland Shaft, in Trumbull county, just west of the State line, I found it to be 235′.

Adding say 25′ for the Sharon fireclay, shale and Conglomerate, we may call the actual thickness of the Conglomerate series, as represented by fig. 14, 250′.

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§ 25. *The Homewood Sandstone.*—This formation, so variable in Lawrence county, preserves in Mercer county a remarkable constancy, and seems to thicken northward.

In Lawrence county, it often wholly turns to sandy shales; but in Mercer county I found but one such case. With this exception, we never sink beneath the horizon of the *Brookville Coal*, without encountering a very massive and, often very conglomeratic sandstone, from 30′ to 70′ thick.

On Wolf creek, it is seen rising from the bed of the stream, at Courtney's mill, as a massive, coarse, grayish-white rock.

In any of the streets of Mercer, the county seat, leading to the summit of the hill, it may be seen with its base 110′ above railroad level.

On Crill's run, west from Pardoe, it forms cliffs, and the fall of 35′ at the saw mill.

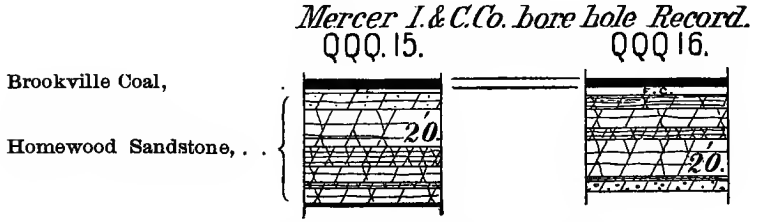
On Sandy lake, near Stoneboro', it immediately underlies the *Brookville Coal*, and encircles with a 30′ cliff-wall the head of a ravine south of the lake. North of the lake it makes a line of cliffs around the hill, at the head of the run descending from Lowry's coal works.

Its constitution may be seen from the following records

of two of the Mercer Iron and Coal Company's drill holes: One, Fig. 15, 1½ miles south-west of Stoneboro'; the other, Fig. 16, half a mile north of the first.

Figs. 15, 16. Stoneboro' bore-hole records.

Brookville Coal, . .	4′ 6″		. . . . .	4′ 6″	
Fireclay, ...	2′ 0″		. . . . .	3′ 6″	
Gray rock, . . . 9′			fine sandstone, . 8′		
white sandstone, 20′			white, " 10′		
gray " 10′	59′ 0″		gray, " 6′	51′ 6″	
white " 9′			white, " 20′		
gray " 3′			gray, " 2′		
white " 8′			pebbly, " 5½′		
Coal bed, ...	?		. . . . .	?	
	65′ 6″			59′ 6″	



It forms also the cliffs along the west bank of Sandy creek, near the northwest corner of Sandy Lake township, and is there very conglomeratic.

It caps Keel Ridge in Hickory township, and has been a protection from further erosion. The driller of a hole on the summit of the ridge reports the thickness of what remains of it at 68′.

It is in some parts of the county a very good building stone, and in other places a coarse conglomerate.

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§ 26. *The Upper Mercer Iron Ore Shales.*—Five to ten feet of shales often underlie the Homewood Sandstone, but are sometimes absent, in which case the sandstone rests directly on a coal bed.

Occasionally a bed of iron ore appears not far below the base of the sandstone, and rests on the *Mercer Upper Limestone.*

At Cozad's, about two miles west of Mercer, the ore was once mined for old Oregon furnace. Where the limestone was thick the ore was thin, and vice versa. The ore was in places 2′ thick, and reported to be quite rich.

At Stranahan's, a little south of Cozad's, ore was once extensively mined for Oregon and Iron City furnaces, long since in ruins.

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§ 27. *The Mercer Upper Limestone.*—This is the "Mahoning Limestone" of Rogers, (Geol. of Penn., 1858,) who recognized it on the Mahoning river, but not in Mercer county, where, in fact, it can only be seen at a few localities. As I found it near Mercer, while the report of Lawrence county was going through the press, I was able to apply to it in that report the less embarrassing name of *Mercer Upper Limestone.**

It was once quarried at Cozad's, on the Sharon and Mercer road, at the foot of Devil's Hollow, as flux for Oregon furnace. It here lies 30′ over the *Mercer Lower Limestone*, and carries its own ore.

At Stranahan's, a little south of the last, it appears in the following section, Fig. 17.

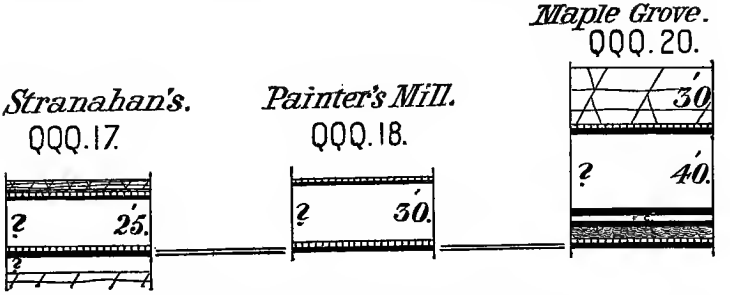
Fig. 17. Stranahan Section:

Sandstone, shaly,	5′
Iron ore,	1′
Mercer Upper Limestone,	2′
Mercer Upper Coal,	1′ 6″
Concealed,	25′
Mercer Lower Limestone,	2′
Mercer Lower Coal,	2′ 6″
Concealed,	8′
Connoquenessing Upper Sandstone, massive,	—
	47′

* The *Mahoning Sandstone* having been named during the First Survey from the Mahoning *creek* in Indiana and Jefferson counties, it was confusing to have a Mahoning Limestone, much lower in the series, named from the Mahoning *river* in Lawrence county.

It is here quite ferriferous. The fragments on the old dump heaps furnish many mollusks and crinoidal joints.

When it is said above that this *Upper* limestone is of limited extent in Mercer county, the reservation must be made that some of the recorded exposures of the *Lower* limestone may be exposures of this bed. In almost every part of the county where this part of the series is well exposed, one of the limestones may be seen; but the two limestones are nowhere seen in the same section, except around Mercer, and at two other localities.



At Painter's Mill both limestones are visible in the following section, (see Fig. 18 above) carefully leveled by Mr. F. H. Oliphant, Jr.:

Fig. 18. Painter's Mill Section.

Mercer Upper Limestone,	2′
Mercer Upper Coal,	1′
Concealed,	30′
Mercer Lower Limestone,	3′
Mercer Lower Coal,	1′ 6″
	37′ 6′

In Lawrence county, (see Report QQ,) where I have followed both limestones over large areas, the lower one is the more persistent of the two, and therefore, in this report on Mercer county, I have assumed its existence in preference to the other wherever I could find but one, unless I could actually measure up to the *Brookville Coal bed*, and a short interval made the Upper one more probable. For there is usually an interval of 70′ or 75′ down to the Lower, and of only 40′ or 50′ down to the Upper limestone.

§ 28. *The Mercer Upper Coal.*—This bed is seen wherever the Upper limestone is recognized, and immediately underneath it. It exists also in places where the limestone is absent.

In no place in Mercer county have I seen or heard of a coal bed *above* the *Mercer Upper Limestone*, corresponding to a pretty persistent coal bed, which I have called the *Tionesta Coal** in my report on Lawrence county, where the Homewood Sandstone is thin, but which it would be safer to call, provisionally, the *Mt. Jackson Coal* of Lawrence county, from the locality where it is mined by Mr. Wallace. See QQ, page 128, Fig. 40.

The *Mercer Upper Coal* is now mined at only a few localities in the county.

At Mr. Lyle's Mercer coal bank in Wilmington Township it shows this structure: *Coal*, 2′; Fireclay, 10″; Coal, 1′; total, 3′ 10″; and lies 21′ above the *Mercer Lower Limestone*. Being quite sulphurous and slaty it is not highly valued.

It was once opened near the southern edge of Wilmington township, over the line, and reported 3′ thick, upper half *cannel*.

A dirty, impure, almost worthless coal, 15′ above the *Mercer Lower Limestone*, and called "*the four foot vein*," mined on Mr. Dick's land, northwest Wilmington, is probably this bed.

It is seen also in Devil's hollow, along the Sharon road, just west of Mercer, 2′ thick, and 25′ above the *M. L. L.* It was once stripped out of the hill along the road, but seems somewhat slaty and impure.

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§ 29. *The Mercer Shales.*—The interval between the last coal and the *Mercer Lower Limestone* is generally 25′ or 30′,

[*This name I have expunged from the Special Report, Second part of QQ, Lawrence county, because it was applied by me in 1841 to a coal bed under the Tionesta Sandstone of Forest county, the place of which, in the series has not yet been demonstrated.—J. P. L.]

occupied by dark, sandy shales with many iron ore balls, and often a layer of iron ore 1′ to 2′ thick on the limestone.

This interval widens to 58′ at Maple Grove, northeast Sandy Lake township, at the Venango county line, with a total change of character as shown in the following section. (See Fig. 20 above.)

Fig. 20. Maple Grove Section.

1.	Sandstone, massive, making a bluff,		30′
2.	*Mercer Upper Limestone (?)*,		2′
3.	*Mercer Upper Coal (?)*,		2′ 6″
4.	Concealed,		40′
5.	*Maple Grove Coal*, Coal,	4′	9′ 6″
	Fireclay,	4′	
	Coal,	1′ 6″	
6.	Shales,		6′
7.	*Mercer Lower Limestone*,		2′ 6″
8.	*Mercer Lower Coal*,		2′ 6″
			95′ 0″

This section is so anomolous that I was at first inclined to believe that No. 2 represented the *Ferriferous Limestone;* and No. 7 the *Mercer Upper Limestone;* and to ascribe the thinning of the interval, which ought to be about 100′, to the northerly direction.

But No. 5 is an extremely local deposit, confined to two or three farms, and seen in no other part of the county. A *Mercer Middle* coal bed is however seen at one or two other places in Lawrence county.

The upper member of this Coal is extensively mined by the *Maple Grove Coal Company*, and shipped by a branch rail to Ray Milton, and thence by the Jamestown and Franklin line. It is a very fair coal, coming out in large rectangular blocks, tolerably free from pyritous slate.

---

§ 30. *The Mercer Lower Iron Ore*, 6″ to 2″ thick, is seen in many places resting directly on the *Mercer Lower Limestone*, or entirely replacing it. In early times it furnished the chief supply for Clay, Oregon, Iron City, Big Bend, New Hamburg, Harry of the West, and Mineral Ridge

charcoal furnaces, now for many years all out of blast. But their existence and number stand in evidence of the extent and value of the deposit.

Keel Ridge was named from a chain of red ore bogs, deposited around it by springs issuing from the ore bed. The bog ore, often 4′ or 5′ thick, was also smelted at the Clay furnace. The mother ore, under the hill, is a layer of carbonate of iron, 2′ thick, and fossiliferous.

In western Jefferson township, on McCullough, Zahneizer, and McDowell's lands, a solid plate of ore, 1½′ to 2′ thick, has been extensively mined, and shipped to the Sharpsville furnace and Clay furnace. No limestone has ever been reported at any of the openings, and the ore bed seems to have taken its place. But a small coal bed is reported to underlie it.

South of Hadley station one mile, on the Mizener and other farms, the same ore bed was once extensively mined for Mineral Ridge furnace, 1½′ thick, and no limestone seen.

On the Otter Creek and New Vernon township line, lie the extensive ore mines of the old Harry of the West furnace. The bed here varied from 1′ to 3′, and no limestone seen. A few feet below it lies a 6″ to 8″ coal bed.

West of Milledgeville one mile, where the coal is mined, the ore, 8″ thick, and rich, is seen in the roof, 4′ above the coal.

In Sandy Lake township, on Wallace's farm, the ore was once mined from the roof of the coal for Mineral Ridge furnace.

In Shenango township, on the Byers and other farms, the ore bed, 6″ to 1′ thick, lies directly on the limestone, and was once extensively mined for Middlesex furnace.

---

§ 31. *The Mercer Lower Limestone* is widely traceable through Mercer county, from north to south and from east to west, either as a limestone or as an iron ore bed, or both combined; although, as has been already said, some of its

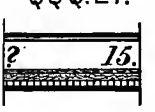
reported outcrops may properly belong to the Upper limestone.

It is always a dark gray or bluish rock, blue predominating; sometimes slaty, splitting off in thin plates or slab-like pieces; always richly fossiliferous, and especially rich in mollusks and crinoids, the broken stems of which often make up a considerable part of the mass.

Coming from Lawrence county it is first seen at Lyle Mercer's, in South Wilmington, in the following section, Fig. 21:

Fig. 21. Lyle Mercer Section.

1.	Concealed.		
2.	*Mercer Upper Coal,* Coal, ... 2′ / Fireclay, . . 0′ 10″ / Coal, ... 1′	3′ 10″	
3	Concealed, ...	15′	
4.	*Calcareous* shale, ...	2′	
5.	Shales, sandy, ...	4′	
6.	*Mercer Lower Limestone,*	3′	
7.	*Mercer Lower Coal,*	2′ 6″	
		30′ 4″	



The calcareous shale, No. 4, a sort of futile repetition of the limestone deposit below it, has been noticed nowhere in the county but here. It is full of limestone nodules, which are fossiliferous.

The limestone is quarried to some extent, 4′ thick, on Mr. Dick's land, near the north-west corner of Wilmington, but slacks imperfectly.

It roofs the Carbon Coal Company's mines on Mrs. Love's land, South Lackawannock, and its light blue fossiliferous fragments surround the air shafts.

North of Bethel, West Lackawannock, Wise farm, near the Snyder Coal Company's shaft, it is quarried in two layers, 20″ of limestone, the upper layer the purest, making good farm lime.

Here it lies exactly 160′ above the *Sharon Coal.*

In Keel Ridge, Hickory, it underlies about 100 acres of the Hoagland and other farms; 4′ thick, reported; 3′ thick where exposed at the old ore drift. It is purer than usual

here, and was used as flux by one of the Sharpsville furnaces, and at Clay furnace. It is a mere mass of fossils.

West of Mercer 1½ miles, along the Mercer and Sharon road down Devil's hollow, it shows itself 2′ thick, 25′ below the *Mercer Upper Coal.*

At Mercer, just above the Newcastle and Franklin railway station, and about 100′ above the track on McDowell's land, it has been cut in a coal drift.

At Crill's falls, Crill's run, it shows itself 2½′ thick, 10′ below the base of the *Homewood Sandstone.** But at Painter's mills, a short distance further north, its thickness is 3′, and the interval 31′.

At Stoneboro', on the north shore of Sandy lake, it is seen 70′ below the *Brookville Coal.*

Near Sandy creek, south, and near the county line, on McClelland's land, it was once quarried for the old Reed furnace.

At Maple Grove Coal Works, north of the last, it shows in the mine entry, varying in thickness, disappearing and reappearing over the coal.

In Mill Creek township, still further north, it is burned for lime in many localities, by Messrs. Blatt, Chateley, Fulk, Moore, and others.

In French Creek township, about 3 miles south of the Crawford line, and on its last outcrop towards the north, it was mined at Cooper's, near Deer Creek church.

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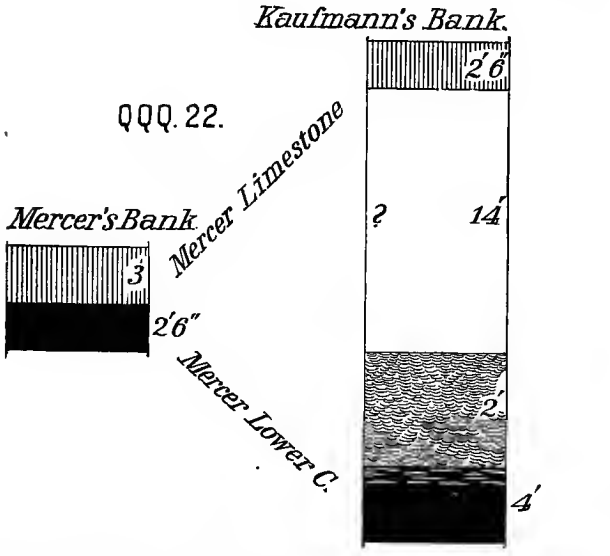
§ 32. *The Mercer Lower Coal* sometimes immediately underlies the limestone; sometimes lies 20′ beneath it; the variations of interval being often sudden. Compare the following two sections; Fig. 22 being at Lyle Mercer's Coal bank B, and Fig. 23 at Kauffman's Coal bank, one mile south of Mercer's.

Fig. 22, Mercer's.		*Fig. 23, Kauffman's.*	
Mercer Lower Limestone,	3′	*Limestone,*	2′ 6′
		Concealed,	14′
		Shales, sandy,	6′

[*This must surely be the Mercer Upper Limestone.—J. P. L.]

Mercer Lower Coal, . . . 2′ 6″	*Coal,* slaty, . . .	1′ 0″	4′
	Coal, good, . . .	1′ 2″	
	Cannel, ...	0′ 8″	
	Coal, ...	1′ 2″	
5′ 6″			26′ 6′



To the question, Is it the same bed? the answer is, no other coal comes below the limestone at either place, and at Kauffman's the whole interval between limestone and coal is visible.

At Lusk's bank, near the southeast corner of Wilmington, the coal shows an upper bench of 2′; a parting of shale, 3″; and a lower bench of 6″; in all 2′ 9″. The coal is somewhat slaty and sulphurous; and nothing is seen of the limestone, which is probably absent.

QQQ.23.

The coal sometimes greatly resembles that of the block coal from the Sharon bed, 160′ lower in the series. Specimens from a boring on Mrs. Love's place, southwest of Lackawannock, were pronounced "Block coal," and an expensive colliery was erected by the Carbon Coal Company, and a branch track laid to the Sharpsville and Greenville railroad. The bed, 4′ thick, proved slaty and sul-

phurous, and the works were abandoned. The limestone here lies upon the coal.

At Rose's, at the east line of Lake, the bed is mined, 3′ to 4′ thick, with a limestone roof, for domestic use; but the top bench is slaty, and all of it friable and impure.

An abandoned shaft, 40′ deep, may be seen three fourths of a mile south of Rose's.

At Thompson's on the north shore of Sandy lake, it was once opened, 2½′ thick, slaty and sulphury. Here it is known under the local name of the "Second vein;" the Brookville being called the "First vein."

It is workable over an extensive area in eastern Sandy Lake, a mile from the Venango line, both north and south of Sandy creek.

At the recently built extensive colliery of the Oak Hill Coal Company, south of the creek, it varies from 2′ to 4′ in thickness and seems good; having a limestone roof, and a pure underclay. Shipments are made by the Jamestown and Franklin railroad.

At Keho's banks, on the hill-road up from the old Reed furnace, north side of the creek, and 250′ above the water, the bed has been extensively mined for local consumption.

At Reagle's, a mile higher up the creek, the bed is 3½′ thick, and the coal is rather sulphurous; at least unfit for blacksmith use.

At the Maple Grove works the bed has been neglected, because of the large bed ( ) above it. It has here its limestone roof.

In Perry township, at Jno. Smith's mine, one mile north of Hadley station, it varies from 1½′ to 3′; and yields a block coal, holding a considerable quantity of sulphur, and making plenty of ash.

In Mill Creek township it is mined by several persons. At David Grove's, half a mile northeast of New Lebanon, it is 2′ thick, with 10′ of sandy shales over it and then the limestone.

In French Creek township, a rather impure coal bed, 1½′ to 2′ thick, and without limestone above it, has been considerably mined on Fulk's, Moore's, Chateley's and other farms, and is probably the bed we are describing.

In Sandy Creek township, near the west line, a kind of slaty-block coal bed, 2′ to 2½′ thick, has been long mined on Wallace's lands, and hauled to Meadville. It is probably the same bed.

On the opposite bank of the run an Oil City company once spent a good deal of money in an abortive attempt to mine this bed for a larger market.

The *Mercer Lower Coal* may be said, then, to have a low economic value on account of its general impurity. But, being widely outspread through the county, and available in many places, it is of great importance, as affording an abundant supply of domestic fuel of fair quality, where no other and better coal bed is at hand.

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§ 33. *Mercer Lower Ore Shales.*—Beneath the Mercer Lower Coal lie 15′ to 25′ of shales, nearly always of a dark color, and often containing a considerable quantity of bituminous matter.

Nodules of iron ore often pervade these shales. Sometimes a plate or stratum of carbonate of iron, 6 inches thick, appears.

At Wm. McClelland's ore bank for old Reed furnace on Sandy creek, where it was most mined, the following section, Fig. 24, (vouched for by his son who worked in the mine) will show its attitude:

Wm. McClelland's Ore bank.

Mercer Lower Limestone,	2′ 6″
Mercer Lower Coal,	3′ 0″
Shales,	7′ 0″
Iron Ore,	1′ 6″
	14′ 0″

QQQ.24.

The ore was here mined for a long time before the existence of the coal and limestone above it was accidentally revealed by a fall of the roof. The ore is a pure carbonate, yielding from 40 to 45 per cent of iron.

The ore was once stripped along the road through the Devil's hollow, two miles west of Mercer; 1½′ thick; 20′ below the limestone; roof shales quite dark, fissile, and holding a sufficient quantity of ore balls to mine with the plate-ore below, for Oregon furnace near by.

In Sandy Lake township, some ore from this bed, at Wallace's, was sent to Mineral Ridge furnace.

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§ 34. *Connoquenessing Upper Sandstone.*—The first exposure of this upper part of Dr. Newberry's Massillon Sandstone seen on entering Mercer County from the south is in Springfield township.

At B. F. Drake's quarries a cliff, 40′ high, surrounds the head of a ravine. The stone was used for the new courthouse in Mercer. It is light grayish, tolerably coarse, and pebbly near the top of the quarry. The natural face of the cliff is weathered into fantastic cavities.

Near Springfield, at the old Springfield furnace, Dennison's run makes a cascade of 60′ over this rock, which forms the upper line of cliffs along the run. The layers are quite massive; the upper ones pebbly.

At Mercer, it may be seen in the road leading from the railway station up the hill, cropping out just below McDonald's old opening on the *Mercer Lower Coal.*

In East Lackawannock, near the west line, its very massive layers make a perpendicular cliff, 25′ high, at the head of a runlet entering the Neshannock near Iron City furnace.

It forms the cliffs which line the Neshannock below Mercer, high up on the slopes.

Its cliffs extend along the north and south sides of Sandy lake.

In many parts of the county however no exposures of sandrock appear at this horizon; shales taking its place in the series.

§ 35. *Quakertown over-shales and ore.*—These form the roof of the Quakertown Coal bed; and in these roof shales ore is sometimes found; thus:—

In Wild Cat Hollow, south-west of Sandy lake, on Mr. Bromley's land, a one foot layer of siliceous iron ore, lies 2′ beneath the base of the sandstone. Several hundred tons of it are dumped in front of the opening. The Newcastle furnaces rejected it as too lean (32 per cent. iron) and too siliceous.

The old furnace below New Hamburg once used some ore from this horizon mined in Delaware township.

Some quite rich ore from the same deposit was once mined along the Newcastle and Franklin railroad, near the Lawrence County line, and used as a mixture for lake ore by one of the Middlesex furnaces.

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§ 36. *The Quakertown Coal bed*, first recognized and assigned to its proper geological horizon in Lawrence county, proves to be quite persistent throughout Mercer county, and has been mined at various places.

Like all these lower coal beds it shows a decided tendency to run into block coal, but never so pure as the Sharon block.

In East Lackawannock, near the west line, it was once mined, 2′ thick, to run the engines of the old Iron City furnace, but was found to be too slaty for other purposes. It outcrops along the little stream putting into the Neshannock near the furnace.

In Springfield township, a quarter mile below Campbell's run, it was once mined about 100′ above the Neshannock water level, as a bed of bituminous shale with streaks of coal, 3′ thick.

At Springfield Falls, on Dennison's run, it is seen in the cliffs, 1½′ thick, and somewhat slaty; it was tried and rejected by the old furnace there.

In Jackson township it was mined on the Comstock farm, and called the "Comstock Vein." It has been recently

opened on Orr's land, near the level of Mill creek; dipping eastward as far as the entry has been driven; 2′ thick; somewhat slaty, with the general appearance of block coal; roof, black slate; visible base of the cliffs above, 20′ above the coal.

The level of this gangway is 110′ lower than that in the *Brookville Coal*, two miles distant to the eastward; therefore 20′ to 30′ must be added for dip, to get the actual geological interval between the two coal beds.

A mile further down the creek, at Harrison's, the coal was once stripped in the water.

Around Sandy lake and Stoneboro', this *Quakertown* coal bed is known by the local name of the "Third Vein," and seems to have been mistaken for the *Sharon* coal bed, in the Geology of Pennsylvania, 1858.

West of Stoneboro', in Wildcat Hollow, it was mined to run the oil borers' engine; 2′ 4″ thick; somewhat slaty and sulphurous as usual.

On the road descending from the Mercer Iron and Coal Company's works its crop shows about 135′ beneath the *Brookville coal.* The *Sharon coal* should be found 80′ to 100′ below it, for that is the Quakertown-Sharon interval in the Mahoning Valley and elsewhere.

The Quakertown coal was once opened in a ravine on the north side of Sandy lake, but I could learn nothing respecting thickness or quality.

It may be represented at the Oak Hill Coal Company's works, on Sandy creek, by a blossom of coal visible 70′ beneath the *Mercer Lower Coal;* but only a few inches thick where cut by a miner locating a tramway.

Armstrong's old bank, in northeast Worth, 140′ beneath the *Brookville Coal*, may be on this bed; here 3′ thick, with a 6″ central slate.

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§ 37. *Quakertown under-shales and ore.*—These range from 20′ to 50′ in thickness; usually composed of sandy layers; sometimes containing nodular masses of iron ore.

The *Mountain Limestone*, (Umbral, Mauch Chunk No.

XI,) or *Maxville Limestone*, of Southern Ohio, should be found here. For a description of it on the Mahoning river at Lowellsville, O. and a discussion of its bearing on the place of the *Sharon Coal* see § 51 below.

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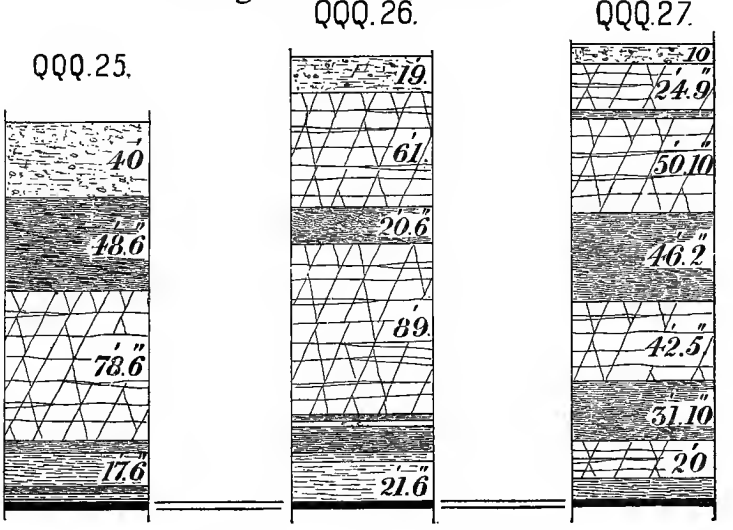
§ *38. Connoquenessing Lower Sandstone.*—In spite of its local indefiniteness and variability there is a distinctly marked massive *lower* sandstone horizon, 30′ to 50′ beneath the *upper*. In one place as much as 90′ of sandstone was found; in another place none at all could be detected.

Borings at Madge Farm.



At Campbell's Mill, on Campbell's run, in Springfield township, this deposit causes a cascade 40′ high, over quite massive layers of grayish white sandstone, with a considerable tendency to false or current bedding.

At McClary's quarry, one mile east of Sharon, good building stone is got from it, although some of the layers are rather hard, and dress with difficulty.

It is 50′ thick and quite. massive where well exposed by a run on the north shore of Sandy lake.

It is 30′ thick and quite pebbly at the Greenville Coal Company's slope, west of Greenville, in West Salem.

Three borings on the Madge farm, the first one half a mile south of Greenville, and not half a mile a part, will suffice to exhibit the extreme local variability of the sand and shale deposits at this stage of the series. Equally violent fluctuations may be noticed in the hillside exposures.

Fig. 25. Madge Farm boring, No. 1.

0.	Surface, ... 1205′ above ocean level, ...	0′
1.	Drift, ...	40′
2.	Black slate, ...	48′ 6″
3.	Connoquenessing Lower Sandstone, ...	78′ 6″
4.	"Slate Rock,"	7′
5.	"Slate, dark gray,"	17′ 6″
6.	Slate, gray, ...	4′ 3″
7.	Slate, dark gray, ...	4′
8.	Black slate, ...	1′
9.	*Sharon Coal*, ...	3′ 2″
		203′ 11″

Fig. 26. Madge Farm boring, No. 4.

0.	Surface, ... 1224′ above tide, ...	0′
1.	Drift, ...	19′
2.	Connoquenessing Upper Sandstone, ...	61′
3.	Slate and shale, ...	20′ 6″
4.	Connoquenessing Lower Sandstone, ...	89′
5.	"Slate, dark gray,"	4′
6.	Fireclay, ...	3′
7.	"Slate, light gray,"	3′
8.	Black slate, ...	10′ 6″
9.	Slate, light gray, ...	4′ 6″
10.	Slate, hard gray, ...	21′ 6″
11.	*Sharon Coal*, (. . . . .)	3′ 6″
		239′ 6″

Fig. 27. Madge Farm boring, No. 5.

0.	Surface, ... 1251′ above tide, ...			0′
1.	Drift, ...			10′
2.	Connoquenessing Upper,	Sandstone, ...		24′ 9″
3.		Slate, gray, ...		4′
4.		Sandstone, ...		50′ 10″
5.	Slate, gray, ...			46 2″
6.	Connoquenessing Lower Sandstone, ...			42′ 5″
7.	Slate, dark gray, ...			31′ 10″
8.	Sandstone, very hard, ...			20′
9.	Slate, light colored, ...			11′ 5″
10.	*Sharon Coal*, (. . . .)			3′
				244′ 5″

In the second hole (fig. 26 above) the 61′ and 89′ sandrocks are said by Mr. Pierce of Sharpsburg, under whose auspices these borings were made, to be very massive and solid throughout. Yet the 89′ rock appears in the third hole as 42½′.

It is noticeable that the base of the Sandrock lies above the *Sharon Coal* bed 33′, 46′, 63′, in the three holes respectively.

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§ 39. *Sharon Coal riders.*—Such is the name given by the miners to thin local patches of coal, deposited in the Sharon over-shales, at various heights above the main bed; never more than 1′ thick, never persistent for any distance and wedging out to nothing suddenly.

Perhaps the horizon at which one is surest to be found is about 45′ over the main coal.

Two were found in sinking the Hickory Coal Company's shaft near Bethel: one at 65′ above the main bed, 3″ thick; and another at 45′, 11″ thick.

In Home shaft No. 2, 6″ of coal lay just under the Sandrock, 50′ above the main coal.

In the old Phillips shaft, just west of Keel Ridge, 9″ of coal occurs 22′ above the main coal.

Sometimes three thin seams of coal have been found above the main bed so extensively mined around Sharon; and it is evident from the Geology of Pennsylvania, Vol. II, 1858, that the First Survey sometimes mistook one or other of these *riders* for the *Sharon Coal* proper.

No coal bed has ever been seen *beneath* the Sharon in this district.

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§ 40. *The Sharon Upper Shales and iron ore.*—From the base of the *Connoquenessing Lower Sandstone* down to the Sharon Coal is generally about 30′; but the interval varies greatly; sometimes sinks to nothing, in which case the Sandstone comes down to the coal; sometimes rises to

70′, in which case the mass of interval shales holds both rider coal beds and layers of nodular or even plate ore.

The shales are usually dark, or bluish gray; but light gray shale is also found. The constitution of the deposit is so very various that beds of sandstone of flinty hardness may appear as parts of the group. (See, for example, the 20′ bed, 11½′ over the Sharon Coal in Fig. 27, above.) In some instances the sandstone forms a roof to the coal; and in others cuts the coal out and lies upon the floor.

The Ore was once stripped near the mouth of Pine run, in Findley, for old Springfield furnace; no regular deposit; merely ball ore in the shale.

It is a local mining superstition that the Sharon Coal bed is always absent from localities where the shales contain ore. Hence—

On Zuschlag's, Kirk's, and other farms, along the northern line of Pymatuning, where an ore deposit 2′ to 3′ thick was extensively mined for Greenville furnace, no one thought it worth while to explore or bore for the coal, although it was in force over a large area only two miles away to the west. But—

Mr. Zuschlag, sceptical of the miners' maxim, and seeing no necessary connection between the presence or absence of the two minerals, drilled a trial hole 25′ below the ore, and found the *Sharon Coal* at its largest size, 5 feet. It is quite possible that the bed lies ignored on account of this superstition in other parts of the district; for no good reason can be given why the ore above should exclude the coal below.

---

§ 41. *The Sharon plant shales* are merely the lower layers of the shales last mentioned.

These *roof shales of the Sharon Coal* are often quite rich in fossil plants. The best locality for observing and collecting them which I have seen is at the Snyder Coal Company's shaft, on Wise's farm, near the west line of Lackawannock.

Here the Sharon shales are 35′ thick, and seem to be

crowded with finely preserved plants. I noticed numerous specimens of the following species:

Alethopteris lonchitica.
Alethopteris grandifolia.
Pecopteris inflata, Newby. ined.
Sphenopteris macilenta.
*Whittleseya elegans.**
Lepidodendron, several species.
Sigillaria, " "
Cardiocarpus, " "
Trigonocarpus, " "
Cordaites, " "

Another excellent locality for fossil plants in the Sharon shales, is at the Morris Coal Company's shafts, near the northern Pymatuning township line.

They are also quite abundant at the Oakland mines, in Hickory; especially at Oakland No. 1.

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§ 42. *The Sharon Coal.*—In Report QQ (see index to beds, p. 323) I have shown that this bed lies from 250′ to 300′ below the *Ferriferous Limestone*, and consequently far below the top of the Conglomerate No. XII, in Lawrence county.

In my survey of Mercer county, I have obtained two direct measurements of the interval from the top of XII (Homewood Sandstone), down to the Sharon Coal.

* The occurrence of *Whittleseya elegans* at this locality is worthy of note, as bearing upon the presence or absence of a fossil plant from the flora of any particular region. I have, with the utmost care, examined the Sharon shales at every locality in Mercer where the Sharon coal has been mined, and never could find a trace of this beautiful and easily recognized plant, until I saw it at the Snyder shaft, where it occurs in great abundance. Neither have I been able to see it in Mahoning and Trumbull counties, Ohio, where I have made a great many examinations of these same shales. Hence it could have been almost certainly concluded that the habitat of this plant did not range far eastward from where it was first found by Dr. Newberry, in Ohio. But its occurrence at this single locality, and apparent absence at all others in the "Block" coal region, shows how unsafe it is to assert the complete absence of a plant from any flora, merely because it has not been seen.

1. At Keel Ridge, Hickory township, 225′.

2. At the Cleveland shaft, Trumbull county, Ohio, just west of the State line, 235′.

In the Geol. of Penn. 1858, Vol. II, pp. 585–6, the generalized Allegheny river section (QQ, 46*) makes it 237′.

Its systematic relationship to the Conglomerate Series, will be discussed in § 51, below.

The irregularities of its geographical distribution are well described by Dr. Newberry in the Ohio Reports. In Western Pennsylvania it is entirely confined, as a *workable* bed, to Mercer county. The main body of it is found in only one township, Hickory; but it occurs in considerable patches in the four line townships, Shenango, Hickory, Pymatuning and West Salem, and extends into the edges of the tier of townships bordering them on the east.

These patches or little basins seem to have little or no connection with one another. On one farm it may be mined, and on the neighboring farm not a trace of it can be found; or it may underlie only a few acres;—an irregularity due partly to the uneven floor on which its vegetation grew, and partly to an erosion of the bed previous to the deposit of its over-rocks.

It almost always exhibits the *splint* or *block* structure, and has long been used *uncoked* in the iron furnace. This quality is due 1. to its low percentage of bituminous matter, and 2. to the distribution of its bitumen in thin layers, between layers of mineral charcoal, so that the mass is prevented from *caking*.

Dr. Wormley's analysis of the coal from the Briar Hill mines near Youngstown, O., is as follows (See Geology of Ohio, Vol. III.)

Specific gravity, ...	1.284		
Moisture, ...	3.60		
Ash, ...	1.16	Sulphur, ...	0.85
Volatile Matter, ...	32.58		
Fixed Carbon, ...	62.66		
	100.00		

Mr. J. S. Lilienthal's ultimate analysis of the coal from the Foster bank, is as follows. (See Geol. Ohio, Vol. III.)

Carbon,	77.88		
Hydrogen,	6.56	Phosphorus,	a trace.
Nitrogen,	1.51	Iron,	0.11
Oxygen,	10.57	Moisture,	3.28
Sulphur,	0.64	Oxygen in ″,	2.92
Ash,	2.84	" in Coal,	7.65
	100.00		

The thickness of the *Sharon Coal* bed when fully developed is 4′, occasionally swelling to 5′, but frequently shrinking to 2′, below which thickness it is seldom mined.

The quantity of Sharon coal remaining unmined is hard to calculate, because new areas of it are discovered every few years. But the best informed men in the valley state, that more than half the known available coal has been extracted; that 25 or 30 years more mining will practically exhaust the known areas; and that, making a liberal allowance for areas to be discovered, and at the rate of production for the last 20 years, 50 years more will certainly exhaust the whole.

This calculation should affect the building of new iron furnaces; for when the Sharon bed is exhausted, furnaces in Mercer county drawing their fuel from Pittsburgh could hardly compete with furnaces situated nearer the source of supply.

The easternmost mine on the *Sharon Coal* is Mason's old stripping on the Neshannock, above Hope Mills and below Mercer, where the bed is 1′ thick.

At Orr's, a short distance below, it was once mined, 3′ thick, coal and shale.

In Western Wilmington, Mr. Pierce, of Sharpville, has recently found a patch of it, 180′ beneath the surface, 3′ thick.

In Lackawannock, a little south of Greenfield, Mr. Pierce has found a considerable area of it on the Madge and Buchanan farms, 275′ beneath the surface, 3′ to 3½′ thick.

The northernmost area of it is in West Salem, just west of Greenville; once extensively mined by the Greenville Coal Company in a long, narrow ridge.

Near the northern line of Pymatuning, it is extensively

mined by the Morris Coal Company and shipped on the Atlantic and Great Western railroad.

Most of the mining of the *Sharon Coal* is confined to Hickory township; and most of the coal going forward by the branch railroad to Sharpsville.

Its considerable area in Shenango township, near Middlesex, has been nearly exhausted, only a small part remaining unmined.

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§ 43. *The Sharon Conglomerate.*—At Sharon, a pebbly sandstone, about 20′ thick, comes to view four or five feet beneath the *Sharon Coal.** It is in two layers, of equal thickness, and without interval.

The upper layer is a moderately coarse sandstone, almost snow white.

The lower layer is a mere mass of pebbles, loosely cemented in a matrix of coarse bluish gray sand, of various sizes but none larger than a large hickory nut, and most of them rounded or waterworn.

The pebble rock is visible along the western border of the county, in Hickory, Pymatuning, and West Salem townships. I have never seen the *Sharon Conglomerate* pebbly east of the Shenango river; but as a massive sandstone it spreads through the central and northern parts of the county.

It is an excellent building stone, when not pebbly, and was the principal material used for the old Beaver and Erie canal locks. The stone is very durable, blocks 50 years old showing the chisel marks as if they were cut yesterday.

In Pymatuning, just west of Transfer, it is very pebbly, large blocks being scattered over the slopes beneath the Sharon Coal.

North of Orangeville, near the State line, it crops out in

* It is called in Report QQ the *Ohio Conglomerate*, because it is the only stratum recognized by the Ohio geologists as representing *the Conglomerate* in that State. But the term cannot be applied in Pennsylvania without producing confusion. *See the next chapter.*

cliffs around the hills, the talus being a mass of pebbles which have weathered loose and dropped down.

Near Greenville, it is changed to a beautiful flagstone formation, and the quarries of "Greenville Flags" are famous through Western Pennsylvania. On the west bank of the Shenango, those of the Leech Brothers, Bortz, Apenburger, and others, yield flagging of any desired size. The layers varying from 2″ to 8″ in thickness, and the faces are almost perfectly smooth.

That this is the *Sharon Conglomerate* is evident 1, from the presence of openings on the *Sharon Coal* immediately above the quarries; and 2, from the pebbly rock exposures a short distance off, on the same horizon.

This change from conglomerate to flagstone may be studied again on the Shenango river, about two miles above the Big Bend.

At Daniel Moyer's quarry, the outcrop of a massive sandstone, 25′ thick, can be traced until its lower 15′ is seen splitting up and becoming flaggy. Some very nice flagging has been quarried here.*

A large amount of flagging is shipped from Greenville to neighboring towns and cities.

Glacial striæ are admirably preserved on the faces of this rock, (when a sandstone,) and may be seen upon them all over the northern part of the county.

Fragments of wood and *fish remains*, are the only fossils I have encountered in this deposit. Fish remains are often quite abundant in it.

Scales, teeth, and spines of *fish*, mostly in a very fragmentary state, may be seen in the massive upper layer, 5′ thick, at Greenville.

*The change is deserving of more study than has been given to it. It would seem, from some considerations, to be connected with the drainage of the country, rather than with the original deposit of the materials. For 1, whenever quarrying has been carried into the hills, the division planes disappear, and the whole deposit becomes massive and solid; 2. The flag quarries are all situated along little streams of water; also where the flags thicken up into massive layers. It is, perhaps, possible that the annual freezing and thawing of the absorbed water may have something to do with the generation of the division planes.

The top layer, also, at Snodgrass' quarry, near Jamestown (near the north county line,) is a mere mass of *fish remains*, so comminuted as to be undeterminable.

A large *Ctenacanthus* spine impression may be seen on a block of the rock, at a quarry near Mosmantown, at the State line.

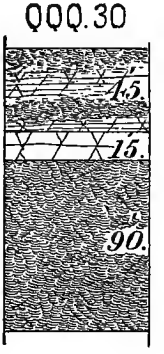
Chapter VI.

The Sub-Conglomerate Measures.

§ 44. About 275′ of measures below the *Sharon Conglomerate* are exposed in Mercer county.*

The upper 150′ of this column is divisible into three well defined and persistent formations, represented by the following general section (Fig. 30.)

1. *Shenango Shales;* sandy shales and flaggy sandstones, ... 45′
2. *Shenango Sandstone;* charged with nodular iron ore and fish remains, ... 15′
3. *Crawford Shales;* argillaceous and bluish, . . 90′



§ 45. *The Shenango Shales* are exposed at several local-

[* These would seem at first sight to represent the *Cuyahoga Shale*, *Berea Grit*, and *Bedford Shale* of the Ohio State Geological Reports, as Prof. White asserts. But the presence of the *Shenango Sandstone* with some of the shales over it and the rest of the shales beneath it, makes a different local nomenclature necessary. It is not impossible that the Shenango Sandstone is merely the Pennsylvania representative of the lower part of the Ohio Conglomerate; which would confine the name Cuyahoga Shales to the lower shales, and leave the upper shales without a name. I have therefore directed Mr. White to find a provisional local name for the sandstone, and he has chosen that of the *Shenango Sandstone*. The shales above it may therefore take the provisional local name of the *Shenango Shales*. Mr. Carll being in the same embarrassment, I have directed him to use for the lower shales the provisional local name of the *Crawford Shales*. The place of the Berea Grit and Bedford Shales will be discussed in other reports.—J. P. L.]

ities in Mercer county, and consist for the most part of flaggy sandstones with interstratified layers of shale.

On Moyer's land, 2 miles above the Big Bend, the deposit is only 36′ thick.

Near Sharon it is 47′ thick.

I have never seen it anywhere more than 50′ thick.

I have found it in species of *Allorisma*, *Sraparollus* and *Orthis*, all Sub-carboniferous forms.

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§ 46. *The Shenango Sandstone.**—This very persistent massive and very ferriferous sandstone may always be found in Mercer County where its proper horizon is exposed.

It is generally a coarse brownish-white rock, often quite soft, usually containing pebbles from the underlying shale, and always large quantities of *iron ore balls*.

It is also very rich in *fish remains*. Every good exposure of it, which I have seen shows them in abundance.

In the Brookfield Coal Company's tunnel it was only 3′ thick, but so siliceous and compact that the workmen were well satisfied to have it no thicker. The hardest granite could scarcely have given them more trouble. It was full of *fish remains*, and *shells* were numerous.

At Whittaker's Falls, a little west of Sharon, it makes the cliff and cascade; is 7′ thick, and has been quarried for building stone.

Along the Shenango it has been quarried in many places for buildings, and for the canal locks; one very extensive quarry being on the right bank just above the Big Bend. Here it is 25′ thick, and 150′ above the water. I saw here on a block the cast of a fine *Ctenacanthus formosus*, Newberry.

At Weikal's quarry, northeast corner of Delaware, it is 20′ thick, and 35′ underneath the *Sharon Conglomerate*, also quarried along the ridge above it. It is here a superior building stone, splitting freely, working easily, and of a

*This is Mr. M. C. Read's *Upper Berea*. Geol. Ohio, Vol. I, page 508. But it evidently has nothing to do with the Berea Grit proper.

grayish-white color, beautifully specked with oxide of iron.

Here a 2′ to 3′ layer near the middle of the mass is filled with *fish remains*. Many balls of ore lie in it, seemingly rounded by attrition, many of them ocherous.

Just below Greenville it forms a massive cliff around the hill, its top 40′ below the base of the (*Sharon Conglomerate*) flagstone quarries.

Near the north county line, one mile northeast of Jamestown, and just below where the little bridge of the Adamsville-Jamestown road crosses a ravine, the rock is seen near Snodgrass' stone quarry.

Near Sharon I found in it some specimens of *Lepidodendron Veltheimianum.*

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§ 47. *The Crawford Shales*, about 90′ thick, are nearly always bluish-gray and very argillaceous, marking the topography with gentle slopes, in strong contrast with the cliff outcrops of the two sandrocks above, and the sharp, steep bluffs of the sandstone next to be described, below. The whole formation answers very well to Dr. Newberry's description of the Cuyahoga Shale, in Ohio.

Meadville Upper Limestone.—About 25′ beneath the top of these shales, a remarkable shell bed was passed through in sinking the slope of the Brookfield tunnel,—a mere mass of mollusks—*Productus*, *Spirifer*, *Orthis*, *Allorisma*, and *Straparolla*, mostly of sub-carboniferous species.*

In close connection with this was another stratum remarkably rich in *fucoids;* which are however quite commonly to be met with throughout the entire thickness of the shales. One of these fucoids very much resembles Lesquereux's *Rotaphycus.*

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§ 48. *The Sharpsville Sandstone.*—This provisional local

* At Meadville the Upper limestone lies about 25′ beneath the Shenango Sandstone; and the lower limestone about 130′.

name is here given to a well defined and persistent group of alternate layers of sandstone and shale, no one of which is more than 5′, and often only 1′ or 2′ thick; the shale layers being usually much thinner than the sandstone layers; the whole group being from 50′ to 60′ thick; the sandstone layers usually of a peculiarly dark grayish-brown color, and fine grain; making an excellent building stone; and quarried in many places along the Shenango river, especially at Sharpsville.

The group, as a whole, makes a strong mark on the topography of all the ravines which cut down through it, in sharp, steep bluffs, strongly contrasted with the gentle slopes of the outcropping soft Crawford Shales above it. It can be thus easily traced from Sharon northwards into Crawford county. I have traced it also continuously from Sharon, up the Shenango and Pymatuning, to the so-called Lower Berea Grit exposures in Ohio, whether the rock at these localities be really the rock of the Berea quarries or not. This admits of some question, as the Berea stone is of a totally different character from that taken from the quarries in Mercer county.

At Sharon, the base of the group is just rising above water-level. The first quarry is on Taylor's land, just above the Westerman Iron Works. Layers of sandstone from 1′ to 2′ thick are here separated by layers of shale from 6″ to 1′ thick.

Near Sharpsville are considerable quarries on the right bank of the Shenango, a short distance above the town; and others on the left bank.

In the railway cut, half a mile above Sharpsville, may be seen, at the base of the group, a layer containing large numbers of *Discina Newberryi*, *Lingula melia*, an *Allorisma*, and a large *Orthoceras*, an inch in diameter; besides many *fish remains;* and water-rounded pebbles of shale.

A little further up the river, on the opposite bank, I found a layer about the middle of the group covered with a species of *Rhynconella.*

At a quarry in Pymatuning township, I saw a large spine of *Ctenacanthus* in one of the blocks that had been split out.

§ 49. *The Orangeville Shales.*—This name is here used merely for the convenience of avoiding in this report a premature discussion of the question of its identification with the Waverly Black Shales of Andrews, or lower member of the Cuyahoga Shale of Newberry.

This is a group of shales, prevailingly blue, but often rusty or reddish-brown on exposed surfaces, always more or less argillaceous, seldom exhibiting sandy layers more than 6″ thick; and containing considerable quantities of scattered iron ore balls.

It is the lowest surface formation in Mercer county; about 75′ thick at Orangeville, near the State line, where most of it is exposed.

The only fossils I have seen in it are *Lingula membranacea*, *Lingula melie*, *Discina pleurites*, and *Discina Newberryi;* these occur, in immense numbers, near the base of the 75′, in the bed of the Pymatuning, at Orangeville, and in the bed of the Shenango at Greenville.*

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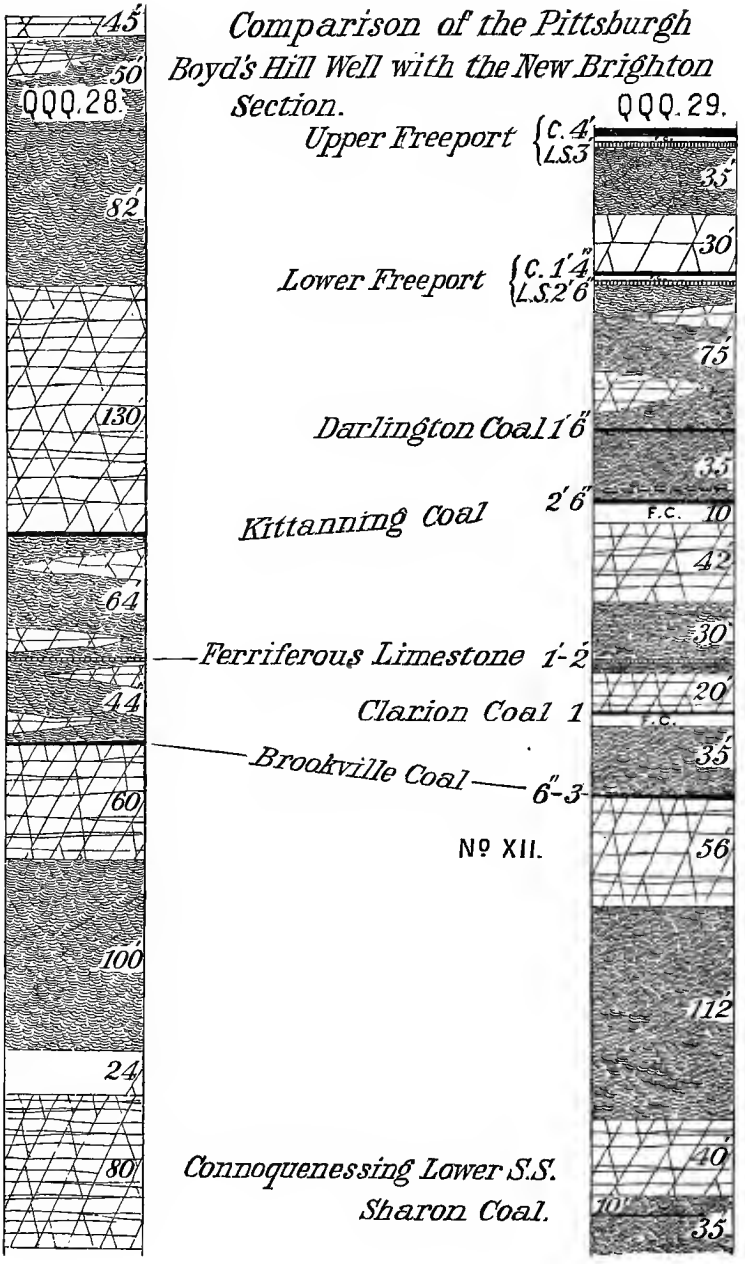
§ 50. The undergrounnd rocks of Mercer county come to the surface in Crawford and Erie counties, and will be described in a future report on that district. But they have been pierced by borings in Mercer county.

A heavy sand rock was struck in the deep hole at Sharon, at a depth of 130′ beneath the base of the Sharpsville Sandstone (base at water level), and 75′ thick, the equivalent of the 124′ rock in the Beaver Falls well, Beaver county, and of the Smith's Ferry oil rock.

**Syringothyris typus* is, according to Dr. Newberry, the characteristic shell of the Bedford shale in Ohio, while the greatest numberof *Lingulæ* and *Discinæ* lie at the base of the Cuyahoga shale. These Orangeville shales may therefore be the lower portion of the Cuyahoga; in which case we must look for the true Berea Grit beneath all the surface rocks of Mercer county; perhaps in the 75′ rock struck (at 185′) in the Sharon Furnace bore-hole (180′ beneath the base of the Sharon Conglomerate). In that case the so called Lower Berea in Vernon and Kinsman townships of Trumbull county, Ohio, would not be any part of the Berea formation.


Comparison of the Pittsburgh
Boyd's Hill Well with the New Brighton
Section.
QQQ.28.
QQQ.29.
45'
50'
82'
130'
64'
44'
60'
100'
24'
80'
Upper Freeport {C. 4' LS 3'
35'
30'
Lower Freeport {C. 1'4" LS. 2'6"
75'
Darlington Coal 1'6"
3.5'
Kittanning Coal 2'6"
F.C. 10'
42'
Ferriferous Limestone 1'-2'
30'
Clarion Coal 1'
20'
F.C.
Brookville Coal 6"-3'
35'
No XII.
56'
112'
40'
10'
35'
Connoquenessing Lower S.S.
Sharon Coal.

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Chapter VII.

The place of the Sharon Coal in the Series.

§ 51. This chapter was written in the early part of 1879 to place before the readers of this report certain difficult problems respecting the measures at the base of the Coal column of Western Pennsylvania and Ohio, for the satisfactory solution of which sufficient data had not been secured, but to which it seemed desirable that the attention of geologists in the field should be directed.

During the present year, 1879, new light has been thrown upon the questions discussed, and it is therefore better to allow this book to leave the press without Chapter VII. This is done at the earnest request of Professor White, who will insert its substance in his next report, on Crawford and Erie counties. J. P. L.

Chapter VIII.

The Iron Furnaces of Mercer County.

§ 52. These were once so numerous that it is impossible to make a half day's journey without stumbling on the ruins of one of them. They smelted the *Mercer Limestone* ores, with charcoal.

The names of all that I could find were Springfield, Oregon, Iron City, Clay, Big Bend, Hamburg, Greenville, Harry-of-the-West, Mineral Ridge, Reed.

The disappearance of these old iron works did not terminate the true history of the iron industry in the county. Block coal took the place of charcoal, and Lake Superior ore that of the native ores, New furnaces became so numerous that more iron was made at one time in Mercer county than in any other area of equal size in the State. At the most prosperous period 22 furnaces were in blast along the Shenango river, in clusters within a few miles of each other.

At Middlesex, 3; of which one, Wheeler Iron Company's Fannie, is in blast. The other two belong to the Shenango Furnace Company.

At Wheatland, 4; James Woods, Son & Co.; all out of blast.

At Sharon, 5; Stewart Iron Company, 2 (one in blast;) Kimberly, Carnes & Co., 1 (in blast); Westerman Iron Company, 2 (one in blast;) and Boyce, Rawle & Company's, 1, Sharon furnace (out of blast.)

At Sharpsville, 6.

Sharpsville; Pierce estate; out of blast.

Mt. Hickory, No. 1, Mt. Hickory, No. 2, } Pierce & Scott; both out of blast.

Spearman; Spearman & Co.; out of blast.

Allen; Henderson, Allen & Co.; out of blast.

Ormsby; Trimble, Fish & Co.; out of blast.

Douglass, No. 1, Douglass, No. 2, } Pierce, Kelly & Co., { out of blast. in blast.

Of the 22 in blast in 1870 there are now (1878) four only in operation.

Each of these four has had a rolling mill for converting its surplus pig into bars and hardware.

Every furnace owned by the same parties, but not attached to a rolling mill, has gone out of blast.

With cheap carrying rates, and its proximity to the lakes, the Shenango valley iron manufacture ought to be a paying business so long as the Sharon coal shall hold out.

REPORT OF THE PROGRESS

OF THE

SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA,

IN

MERCER COUNTY.

BY I. C. WHITE.

PART II

DETAILED GEOLOGY OF THE SEVERAL TOWNSHIPS.

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§ 53. *Liberty.*

Liberty township occupies the south-east corner of Mercer county.

Wolf creek, by which it is drained almost entirely, enters near the middle of its north line, but soon veers eastward, and passes out near the center of its east line, and unites with the Slippery Rock in Butler county.

Wolford's run is the only tributary to Wolf creek of any size within the township, and puts into it from the west, near the big bend in the creek.

All of the minor streams subordinate to Wolf creek have a very slow descent along their beds.

Many swamps are consequently scattered about the town-

ship, of which a very large one, Pine Swamp, lies near its north-eastern corner.

The entire township is covered with Drift, and almost the only rock exposures to be found are those along Wolf creek, where it and its side streams have removed the glacial debris.

These rock exposures extend from 75 feet above the Darlington coal, down to and into the Homewood Sandstone. Nothing is seen above the Darlington coal.

Some high knobs in the south-east part of the township, catch small isolated areas of the *Darlington coal*, and one and a half miles south from the village of North Liberty, the bed is mined by Mr. Foster. See Fig. 31, p. 79.

Fig. 31. Foster Secton; Liberty T.

0. Top of knob,			0
1. Concealed,			75′
2. Shales, dark, slaty,			5′
3. *Darlington Coal*,	Coal,	1′ 0″	3′ 2″
	Slate,	1″ to 2″	
	Coal,	2′ 0″	
			98′ 2″

The lower bench is of much better coal than the upper, being quite pure and free from sulphur, richly bituminous and shining black, except near the outcrop, where the coal has been stained by percolations from above.

The upper bench is somewhat slaty and sulphurous, and is open burning.

The slate band is quite persistent, but never exceeds two inches in thickness, frequently being not more than a quarter of an inch thick.

The coal leaves no cinder, but a rather abundant white ash, and is highly valued for domestic purposes.

The immediate roof of the coal is a dark slaty shale, which contains a great amount of vegetable remains, but in a condition so broken and macerated as to render any specific determination impossible.

A curious conglomerate in the roof of the coal is seen at one point, being a mixture of fragments of wood, angular

and rounded pieces of shale, and often a considerable quantity of cherty matter.*

The mine drain was sunk 15 feet below the level of the coal, and the proprietor informed me that he did not even then reach the *base of the fireclay*, which in some portions was quite pure, and in others contained layers of shale.

The dip is to the south-east, though not at a rapid rate.

There are only about 30 acres of coal in this knob.

About one mile north-west from Foster's, there is some high ground which should catch the *Darlington* coal, if the rise is not too rapid in that direction.

At the village of North Liberty, the *Darlington coal* should also be found a few feet below the surface of the ground; but it is more than probable that it has been eroded, and its place occupied by Drift.

One-half mile east from North Liberty, the *Darlington coal* is caught in a high knob, and mined on the land of Mr. H. M. George, by a shaft 25 feet deep.

The coal shows the same structure here as at Foster's, but it is much more impure, being filled with slate and pyrites to such an extent as to render it almost worthless.

At the top of the shaft a sandstone was passed through, and then dark-bluish shales containing nodules of iron ore.

There are about 30 acres of coal in this area.

Passing from this locality eastward toward Wolf Creek to near the county line we obtain the following section; see Fig. 32, p. 79:

1.	*Darlington Coal*,	3′
2.	Concealed,	90′
3.	*Ferriferous Limestone*,	12′
4.	Slate, dark, fossiliferous,	5′
5.	*Scrubgrass Coal*,	0′ 8″
		110′ 8″

* Compare Quart. Jour. Geol. Soc., London, XXXIII, 932.

No. 1 is here named the "Surface Vein," coming so near the tops of the hills.

Nothing was seen of the *Kittanning coal* which should be found in the interval No. 2; but Mr. George informs me that in digging wells in this vicinity a coal bed has often been passed through, 20″ to 25″ thick, about 45 feet below the "Surface Vein;" and this would represent the Kittanning; but no attempt has ever been made to open it.

No. 3, the *Ferriferous limestone*, is quarried extensively here by Mr. George for agricultural and other purposes. It has its usual peculiar shriveled aspect, and is of a bluish gray color, breaking with a sharp angular fracture, and often glistening with calcite. The layers vary from 4″ to 2′ in thickness.

The lower layers are blue and make the best lime for agricultural purposes; the upper layers make the whitest lime for plastering.

The rock is very fossiliferous, being especially rich in *crinoidal fragments*, whose long cylindrical stems are seen passing across each other in every direction. Many *mollusks* are also to be seen.

No. 5 is the representative of the *Scrubgrass coal;* too thin to mine except by stripping, which has occasionally been done along the bottoms of the streams. It is said to be very pure.

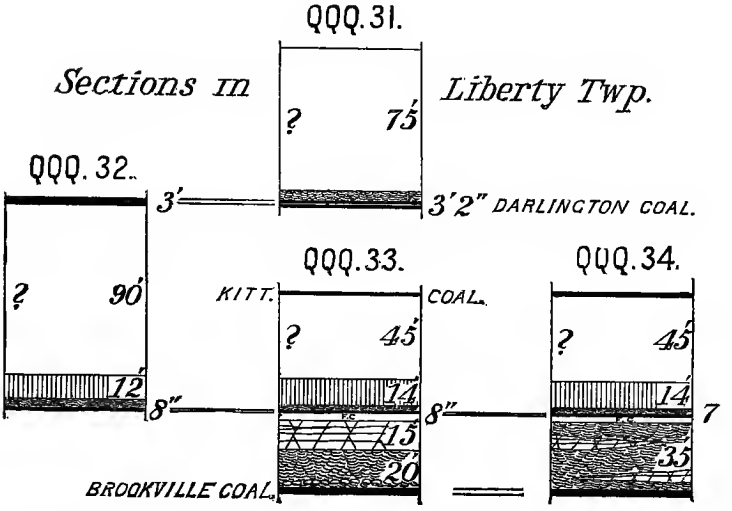
No. 4 shale contains also many fossil shells, usually *Spirifer*, *Athyris*, *Productus*, *Bellerophon*, *Pleurotomaria*, *Macrocheilus*, &c., being the same forms that occur in the limestone above.

Just east from the limestone quarry a bed of coal occurs in the bottom of Wolf creek 35 feet below the level of the limestone, and has been mined by stripping.

About one half mile north from Mr. George's limestone quarry, and descending from the road over the steep bluff of Wolf creek, on the land of Mr. D. F. Courtney, we get Section Fig. 33.

Fig. 33. Courtney Section; Liberty T.

1.	*Kittanning Coal*,	(blossom.)
2.	Concealed,	45′
3.	*Ferriferous Limestone*,	14′
4.	Shales, grayish,	3′
5.	*Scrubgrass Coal*,	0′ 8″
6.	Fireclay,	4′
7.	Sandstone, shaly,	15′
8.	Shales, dark, slaty; ball ore,	20′
9.	*Coal* in bed of Wolf creek,	3′
		104′ 8″



The *Kittanning Coal* (No. 1) is seen in the road, a short distance south from Mr. Courtney's house, who once dug into its outcrop and found it about 2′ thick, but too slaty. But, as a coal bed is generally poor on an exposed outcrop, this bed should be looked after more closely, since it underlies a considerable area, and it may be found on exploration to be a workable bed, as it so often is in Lawrence and Beaver counties.

Mr. Courtney and every one else seemed to have supposed that this was the same bed as that mined on the land of Mr. George, in the previous section. But a comparison of the two sections shows that this is not likely, since the coal mined by Mr. George lies 90 feet above the *Ferrifer-*

ous Limestone, while this comes at only half of that interval.

It should also be remembered that this same bed is an excellent coal, 3 feet thick, only a short distance south from here, at the Old Furnace, on Taylor's run.

The *Ferriferous Limestone* (No. 3) is quite massive at this locality, and forms a line of cliffs on each side of Wolf creek. It has been quarried to a small extent by Mr. Courtney, and it turns into an excellent lime.

The *Scrubgrass Coal* (No. 5) is seen under the limestone at numerous localities along the steep bluffs of the creek.

The *Coal* No. 9 is also mined by Mr. Courtney, in a slope, a short distance above where this section was made.

This coal bed is three feet thick,* in two benches, with a thin parting of slate six inches below the top. It is very solid and quite pure, being shining black and highly valued as a domestic fuel and for smithing purposes.

It is the same coal bed as that mined at Pardoe, Stoneboro', Jackson, Center, &c., and may be considered to be either the Clarion or the Brookville bed.

The dark, slaty shales above it contain many kidney-shaped iron nodules, and also numerous vegetable remains, principally *Cordaites*.

A short distance above where the last section was made, and on the east bank of the creek, on the land of Mr. Brannaman, we get the section of Fig. 34, p. 79.

Fig. 34. Brannaman Section; Liberty T.

1.	*Kittanning Coal*,	2′
2.	Concealed,	45′
3.	*Ferriferous Limestone*,	14′
4.	Shales,	3′
5.	*Scrubgrass Coal*,	0′ 7″
6.	Fireclay,	3′
7.	Shaly sandstone and shales,	35′
8.	*Brookville Coal* in Wolf Creek,	3′ 7″
		105′ 11″

*Mr. Courtney reports that at one point in his bank it attained a thickness of 5½ feet.

The Kittanning Coal (No. 1) was once cut by Mr. Brannaman in excavating a cellar. He reports that he found it about 2 feet thick, although, so near the surface, he could not judge what its character would be under good cover.

The Ferriferous Limestone (No. 3) is here exposed in a constant line of cliffs along the steep bluffs of the creek for 200 rods; and many huge masses have broken away from it and now lie in the channel below. Mr. Brannaman quarries and burns this limestone to a small extent. It is very fossiliferous.

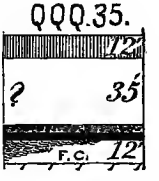
The Scrubgrass coal (No. 5) was once stripped out of the creek's bank, and is said to make an excellent fuel.

The Brookville (Clarion?) Coal (No. 8) has here been taken out of the creek's bed and is a very fine coal, being celebrated for its purity, and is hauled to a long distance into the country as a smithing coal. It soon rises above water level down stream, and has been mined by entry on the land of Mr. Brannaman.

About one fourth of a mile above Mr. Brannaman's we come to Courtney's Mill, and the rapid northward rise of the rocks carries up the *Brookville coal* to a height here of twenty-five feet above the level of Wolf creek. At the entry, a short distance below the mill, may be seen the succession in Section, Fig. 35.

Courtney's Mill Section; Liberty T.

1. *Ferriferous Limestone*,	12′
2. Concealed,	35′
3. Shales,	5′
4. *Brookville Coal, (Clarion?)*	3′
5. Fireclay and sandy shales,	12′
6. *Homewood Sandstone* in Wolf creek,	—
	67′



The Ferriferous limestone (No. 1) here leaves the creek, and cannot be found in its bluffs higher up, owing to the northward rise of the strata.

The Brookville (?) Coal (No. 4) which we have thus far seen constantly along the creek at an interval of 40′ to 45′ beneath the Ferriferous limestone, is here seen in its relation

to the *Homewood Sandstone* No. 6. The interval between it and the *Homewood* Sandstone is quite variable; sometimes running down to not more than five or six feet; so, as no other coal occurs in this interval to represent the Brookville, I have preferred to identify No. 4 with it, and to consider the Clarion Coal wanting in this neighborhood. The coal of this bed (No. 4) continues to be still very good, richly bituminous, and coming out in bright lustrous cubical blocks.

The Homewood Sandstone is brought up here by the rapid rise of the rocks. At the mill 10 feet of this rock can be seen above water level as a very massive, coarse, grayish white rock. In the bed of the creek it is furrowed and cut into ridges by the grinding action of the stream.

About one mile west from Courtney's mill the *Ferriferous Limestone* is last seen on the land of Mr. Redman where it lies 100 feet above the level of Wolf Creek. Its outcrop from here around to the south-west is covered up by the Drift and can be followed approximately by the topography.

---

§ 54. *Springfield.*

This township lies west from Liberty along the Lawrence county line.

The Neshannock is its principal draining stream, and flows south through its western portion, passing out at its south-west corner.

Pine, *Campbell* and *Dennison's runs* flow into the Neshannock from the east; but from the west no tributaries of any size come in.

Swamps or marshes are numerous in the eastern and southern portions of the township, some of them covering many acres; others only a few square rods. A peculiarity of these swamps is that many of them are depressed below the drainage level, and have no visible out-

let; frequently we see them occupying circular depressions which resemble excavations thrown up for fortifications. *These bowl-shaped swamps* may be accounted for in two ways; one is, that the water, finding an outlet by an underground channel, has gradually removed the material held in suspension until enough has been thus carried away to make a considerable depression in the surface. The other and more probable explanation is, that they are due to inequalities in the distribution of the *Drift*. A thick coating of this material spreads all over the township; and it is very probable that the old glacier in its retreat has left its moraine stuff in irregular heaps. Some portions of the ice stream must have contained more débris than others; thus this material might often be left piled up in a circular form, the central depression being where the moraine matter was scarcest; after agencies would tend to retain or even exaggerate the irregularity.

These swamps are often covered with a dense growth of Poison Sumach, Black Alder, and Water Beech, and also where they occur the land has to be under-drained before any agricultural operations are possible.

The section of measures forming the surface of this township extends from the Kittanning coal down to 20′ below the Sharon coal, which rises above the waters of the Neshannock at Leesburg station on the New Castle and Franklin R. R., and continues above water as far as the northern line of the township.

The Sharon coal bed along this line is generally thin and quite impure; often having a semi-cannel structure; and again, showing the "block" type.

The *Sharon Coal* was once mined by stripping near the northern line of the township, along Pine run, on the land of Mr. Orr, just east from where the road crosses the run. The coal was 3′ thick; the upper portion soft and rotten; the middle cannel; the bottom "block." The whole bed was quite impure, containing a large amount of sulphur. It thined away to 1½ feet in a trial drift.

Immediately above this *Sharon Coal* lies a dark shale,

which contains great quantities of "kidney-shaped" iron balls, once mined to some extent for Springfield Furnace.

Just below the coal a small bed of *iron ore* is also reported, as mined for Springfield Furnace.

Over the coal is a steep bluff covered with large blocks of massive *Connoquenessing Lower Sandstone.*

About one mile further down the Neshannock, and on the land of Mr. Drake, a massive ledge of sandstone is seen extending up to 150 feet above the horizon of the *Sharon Coal.*

The top portion of this ledge is very conglomeratic, being composed almost entirely of small quartz pebbles. Sixty feet of rock are exposed in a nearly vertical wall.

Quarry.—The lower portion of this 60 feet is a tolerably coarse-grained grayish white sandstone, and has been quarried to a considerable extent on Mr. Drake's land, for the court house in Mercer. It is an excellent building stone.

Campbell's Mills.—Just below this we come to Campbell's run, and about one half mile east from its mouth are the mills, where the stream descends over the massive *Connoquenessing Lower Sandstone* 40 feet in as many yards. An over-shot wheel 32 feet in diameter furnishes a large amount of power with a very small quantity of water.

The *Connoquenessing Lower Sandstone* is here very massive, but no pebbles are seen in it.

A short distance below the mouth of Campbell's run, Mr. Smith has lately been drifting into the hill after a bed of coaly slate 3 feet thick, seen at the roadside, expecting it to change into pure coal when well under the hill. This slate must represent the *Quakertown Coal*, for it lies 90 feet above the level of the Neshannock, and the Sharon coal comes near the bed of the creek at this locality.

Just over the coal is seen the outcrop of the massive *Connoquenessing Upper Sandstone*, and a short distance under it is a very steep bluff, indicating the presence of

the *Connoquenessing Lower Sandstone*, the same that forms the "falls" at the mills.

After passing above the "falls" at Campbell's mills we see no more rock exposures along Campbell's run until we come to the cross-roads near Mr. Leidy's; and here a small side stream from the south exposes a very massive sandstone in a succession of cataracts. This is very probably Mr. Drake's Connoquenessing *Upper* Sandstone.

Ferriferous Limestone.—At the very southern edge of the township, and near its central line, at the head of Denison's run, a very high and somewhat conical knob, on the land of Mr. Campbell, is capped about a ¼ of an acre of the *Ferriferous Limestone*, with no rock above it, except the covering of débris. It was once quarried and burned by Mr. Campbell. The line between Mercer and Lawrence counties passes over this knob.

A short distance north-west from Mr. Campbell's a still higher knob occurs on the land of Mr. Orr, and catches about 30 acres of the *Ferriferous limestone*, the hill rising above this rock 50 feet at its highest point.

Mr. Orr mines a coal below the *Ferriferous limestone* by means of a shaft, which gives us Section Fig. 36.

Fig. 36. Orr's Shaft Section; Springfield T.

1. *Ferriferous Limestone*,			15′
2. Shales, darkish; balls of ore,			23′
3. *Clarion Coal*,	Coal,	4″	3′
	Slate,	1″ to 2″	
	Coal,	2′ 6″	
			41′

The *Ferriferous limestone* is finely exposed near Mr. Orr's house. Fifteen feet of it is visible, and it may be much thicker as the top is not exposed at the shaft. It is an ashen gray rock, and possesses the peculiar shriveled aspect so characteristic of this stratum. It is also quite fossiliferous.

There must be a *local dip to the north-west* here, for the limestone occurs 40′ lower at Mr. Orr's than at Campbell's;

but this dip is soon reversed, and the limestone is carried over the tops of the neighboring hills towards the northwest.

Mr. Orr states that in sinking his shaft he found no coal below the limestone until he reached No. 3, which would seem to indicate that the *Scrubgrass coal* is absent at this locality.

The Clarion (?) coal (No. 3) shows the same structure as the *Brookville coal* along Wolf creek; but the Brookville bed there comes 40′–45′ below the *Ferriferous limestone*, while the bed here is little more than half so much lower. This may then possibly represent the Clarion coal, but the probabilities are that it is the same bed that we find along Wolf creek with the interval between it and the limestone very much diminished. The coal dips down under a large swamp near by, so that it requires a great deal of pumping to keep the mine clear of water. The coal is quite solid and pure looking, and has an excellent reputation in the surrounding country.

The *Ferriferous limestone* has been quarried and burned by Mr. William Orr and it was once hauled to Springfield Furnace for flux.

Just south from this a high knob on the land of Mr. Jas. Orr catches a small area of the *Darlington coal* in the northern edge of Lawrence county, and it has been described in QQ, page 210.

Denison's run rises in a chain of swamps near the southern margin of Springfield township, and flows at a sluggish pace so that no rock exposures are seen along its channel until we come to Leesburg where it begins to cut into the massive portion of the Conglomerate.

Ascending the hill to Leesburg from the banks of Denison's run we see the very massive *Connoquenessing Upper Sandstone* making a steep bluff around the hill and jutting out of the ground along the road.

An old coal drift is near the top of the hill above the road on the land of Mr. Lusk.

The coal was opened a long time ago and I could learn but little about it, except that it was too thin and slaty to mine. It represents one of the *Mercer coals.*

The *Homewood Sandstone* forms a bluff above the coal opening and many blocks of it are scattered over the ground, and at one place in the road a few feet of the bed rock are seen.

Seeing that the summit of the hill at Leesburg rises 1335 feet above tide, that is, 70 feet higher than the position of the *Ferriferous limestone* on the land of Mr. Orr, 2 miles to the south-east, I was at first inclined to think that the limestone might be caught in the Knob; especially as a rock resembling limestone was reported from the bottom of a well; but as the bottom of the well would be within 10 feet of the top of the Homewood Sandstone, and as no exposures of limestone could be found, it is probably not there.

A short distance north from Leesburg the blossom of the coal opened by Mr. Lusk is seen along the road, 190′ above the Neshannock.

Just west from here this same coal was once mined on the land of Mr. Offet. It is reported to be 2′ 6″ thick but too impure to be valuable as a fuel.

About one third of a mile north from Leesburg Denison's run makes a plunge of 30 feet over the *Connoquenessing Upper Sandstone* and forms the Springfield Falls. Here we obtain the following section; see Fig. 37, p. 89:

Fig. 37. Springfield Falls Section.

1. *Connoquenessing Upper Sandstone,*	50′
2. Quakertown Coal,	1′ 8″
3. Shales,	5′
4. *Connoq. Lower SS.* to run, 100 yards below falls,	50′
	106′ 8″

No. 1 is here very conglomeratic, and it forms the top wall over which the run makes the falls.

No. 2, *the Quakertown coal,* is here seen extending around

the cliff at the "falls" in almost precisely the same manner as in its typical locality, at Quakertown Falls, in Lawrence county. It is only 20″ thick, and quite slaty at that. An attempt was once made to mine it, but the entry was driven only a short distance in impure coal and abandoned.

No. 4 is generally massive, but some flaggy or shaly layers occasionally occur in it.

Here stood Springfield furnace, which used native ores, and went out of blast about 16 years ago. Its overshot wheel, 38′ in diameter, gave 150 horse-power.

The *Sharon coal* has been mined about one fourth of a mile above Leesburg Station, on Neshannock creek, by a slope on the land of Mr. Hoffman. The coal lies only 3 feet above the ordinary level of the creek, and when a rise takes place the mine is flooded. The coal is somewhat slaty and only 2 feet thick, often running down to 18 inches.

Section, Fig. 38, p. 89, was seen here:

Fig. 38. Hoffman's Coal bank Section; Springfield T.

1.	*Connoq. Lower Sandstone,*	35′
2.	Shales containing ball ore,	30′
3.	*Sharon Coal,*	2′
4.	Concealed to Neshannock water,	3′
		70′

No. 2 contains a great many iron nodules and was one of the principal sources from which Springfield furnace obtained its stock.

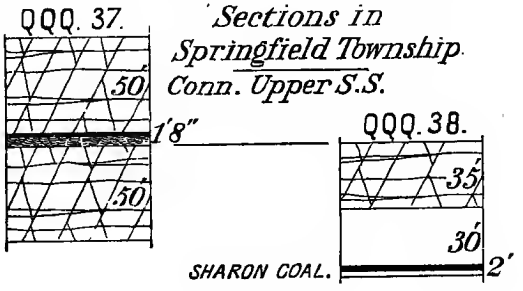
No. 1 is very massive, and makes a cliff around the hill. It was once quarried for excellent building stone.

A short distance below this, and near Leesburg Station, the *Sharon coal* is seen in the bed of the creek. Going further south, it sinks below water level, and its horizon does not reappear until we come to the Shenango, at New Castle, in Lawrence county, and then the coal is gone entirely except a few strings and streaks through the shale where the coal bed should be found.

At Leesburg Station a well was once drilled along the

creek bottom, commencing 10 feet above the bed of the stream, and, according to the report of one of the drillers, nothing but sand and silt was found for 90 feet. This, if true, would show that the creek is now flowing at a considerable distance (80′) above its former bed; which may have been gouged out by a glacial stream.

Near the mouth of Indian run, on the west side of the Neshannock, Mr. Edeburn once thought he had a bed of coal, 20′ above the level of the Neshannock; but it proved to be nothing but a layer of black slate and bituminous shales.



Wilmington.

§ *55.* This township, a long narrow area stretching along the Lawrence County line west from Springfield, is drained centrally by the Little Neshannock, flowing south, through a wide Drift-filled valley.

The West Branch enters the Neshannock near the south township or county line.

This area has considerable interest, geologically, from the fact that it possesses the furthest land to the south-east on which the *Sharon coal* has been found of workable thickness.

In the western portion of the township Mr. Walter Pierce of Sharpsville has lately been drilling for the *Sharon coal*

on the lands of Mr. McFarland, Biddle and others. In many of the wells 3 feet of seeming good "block" coal have been found.

One of these on the McFarland property commenced at 1199′ above tide; descended 155′; and struck the Sharon Coal 3′ thick at 1044′.

Another commenced at 1192′ above tide; descended 157′; and struck the Sharon Coal, 3′ thick, at 1035′.

In many other holes the coal was found of available thickness, and it is the intention of Mr. Pierce to sink a shaft and open up this territory as soon as the condition of the coal trade will warrant the enterprise.

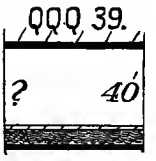
Mercer Lower Coal?—Near the south-eastern corner of this township and near Volant, a coal bed was once opened near the roadside on the land of Mr. Broadbent. The bed is 3′ thick, and lies 180′ above the level of Neshannock creek. It is most probably the *Mercer Lower coal.*

Just over, or south of, the Lawrence county line this same bed was once mined on the land of Mr. McBride; about 3′ thick; but quite slaty.

Just east from McBride's, on the land of Mr. Lusk, we get Section Fig. 39.

Fig. 39. Lusk Section; Wilmington T.

1. *Homewood Sandstone*, massive,			—
2. Coal, reported to be,			3′
3. Concealed,			40′
4. Sandstone,			2′
5. Shales, sandy,			8′
6. *Mercer Lower Coal*,	Coal,	2′ 0″	2′ 9′
	Slate,	3″	
	Coal,	6″	
7. Iron ore,			6″
			56′ 3″



It is quite sulphurous and slaty, but as nothing else can be obtained in the neighborhood, it is used for domestic consumption.

The coal bed No. 2 was once opened on the land of Mr. McBride, but nothing could be learned of it except that it

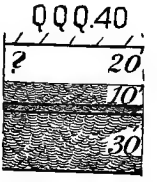
was 3′ thick, and the upper half an impure cannel. It very probably represents the *Mercer Upper Coal.*

A massive sandstone makes a very steep bluff above it.

On the middle fork of the Little Neshannock, and one mile above Lamb's mill, section, Fig. 40, is seen along the road, on the land of Mr. Lane.

Fig. 40. Lane Section; Wilmington T.

1.	Connoquenessing Upper Sandstone, (?) massive,		—
2.	*Quakertown* (?) *Coal;* blossom,		—
3.	Concealed,		20′
4.	Shales,		10′
5.	*Coal,* Coal, impure,	0′ 6″	5′ 6″
	Shales,	4′ 0″	
	Coal,	1′ 0″	
6.	Shales, reported in a boring,		30′
7.	*Coal,*		1′
			66′ 6′



This section exhibits a very singular succession of rocks. For the coal bed, No. 2, comes 70′ below where the *Mercer Lower Limestone* is seen only one half mile to the south; and, as the dip is very small, it would represent the *Quakertown Coal;* and the massive sandstone which shows above it would be the *Upper Connoquenessing.*

The coal bed, No. 5, comes at the level of the run, and an enterprising German once attempted to work it, under the common impression that the shale member would turn to coal when he got well under the hill. The upper part of this bed is quite slaty, while the lower is much better, and has been stripped out along the creek for local use.

Sharon Coal Riders.—Mr. Walter Pierce, of Sharpsville, states that he once bored a hole at this locality, and that 30′ below the level of coal No. 5 his drill passed through one foot of slaty coal, which he supposed represented the *Sharon bed.* This, however, would give an interval of only 140′ between the *Sharon Coal* and the *Lower Mercer Limestone.* I have never elsewhere found this interval to be less than 160 feet. It is, therefore, more probable that both

No. 5 and No. 7 are representatives of the thin coals which often occur in the roof shales of the Sharon, and are termed "rider veins" by the miners.

About one half mile southwest from this we come to the land of Mr. Lyle Mercer, and there Section, Fig. 41, p. 93 was obtained.

Fig. 41. Lyle Mercer Section; Wilmington T.

1.	Concealed,	20′	
2.	*Mercer Upper*, Coal, 2′ 0		
	Fireclay, 10″	3′ 10″	
	Coal, 1′ 0		
3.	Concealed,	15′	
4.	Calcareous shale,	2′	
5.	Shale, sandy,	4′	
6.	*Mercer Lower Limestone*,	3′	
7.	*Mercer Lower*, Coal, slaty, 6″		
	Coal, 2′ 0″	2′ 6″	
8.	Concealed,	100	
9.	Coal blossom,	—	
10.	Concealed to Little Neshannock,	50′	
		149′ 6″	

The *Mercer Upper coal* (No. 2) has here been mined on a small scale. It is quite sulphurous and slaty, and burns out a grate in a short time.

Immediately below it, is a tolerably persistent bed of iron ore 6″–12″ thick, as reported by Mr. Mercer.

The *Mercer Lower Limestone* (No. 6) is a very hard, compact and dark blue rock; the immediate roof of the coal below; richly fossiliferous; quarried and burned to a considerable extent, but difficult to slake.

The *Mercer Lower Coal* (No. 7) has been mined to some extent for local supply. The upper portion is quite slaty, but the lower is much better, being a kind of semi-cannel and in many portions of the bank a genuine block coal.

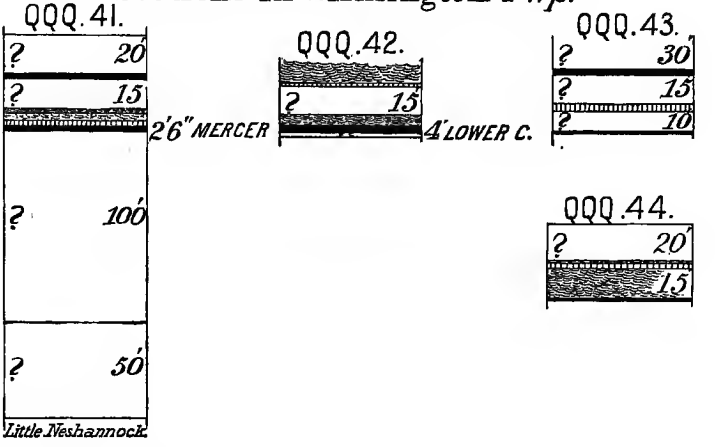
The same bed has been mined a short distance above this by Dr. Popina and Mr. Johnson.

The top of the bed at Mr. Mercer's is 1140 feet above tide according to the levels of Mr. Walter Pierce of Sharpsville, Pa., or 47 feet lower than the level of the *Mercer Lower*

limestone at the Snyder shaft in Lackawannock township, five miles north.

The coal blossom (No. 9) is seen along the road, and is evidently the same as No. 5 of the previous section, Fig. 40. It was bored through once on the land of Mr. Mercer and found to be 14 inches thick.

Sections in Wilmington Twp.



About three fourths of a mile south-west from the last locality the *Mercer Lower coal* is mined on the lands of Mr. Gothard and Mr. Kauffman. At the latter's bank we get Section Fig. 42.

Fig. 42. Gothard's Section; Wilmington T.

1.	Shales,		?
2.	*Mercer Lower Limestone,*		2′
3.	Concealed,		15′
4.	Shales,		6′
5. Mercer L. C.	*a.* Coal, slaty,	1′	4′
	b. Coal, good,	1′ 2″	
	c. Cannel,	8″	
	d. Coal, good,	1′ 2″	
6.	Fireclay,	visible,	2′
			29′

The great variation in the interval which separates the *Mercer Lower limestone* from its underlying coal is a very

noteworthy circumstance. Compare, for instance, this section with the preceding one, Fig. 41. There the limestone comes in direct contact with the coal; here it is separated from the coal by 21 feet of rocks.

It has been quarried here and burned to some extent.

The *Mercer Lower coal* shows quite a variation in quality in its different benches. *a*, the top bench, is quite impure and slaty. *b*, is an inferior quality of "block" coal. *c*, is a tolerably good article of cannel, which, however, often becomes slaty; while *d*, the bottom bench, is a richly bituminous, very good coal.

The bed seems to lie in a limited basin; for it thins down, according to Mr. Kauffman, and runs out almost entirely in every direction in which it can be traced. It is used quite extensively for domestic consumption, and Mr. Kauffman sells about 25,000 bushels per annum.

Near the north-western corner of this township, where the *Mercer Upper Coal* is mined on the land of Mr. Dick, I obtained Section Fig. 43, p. 93.

Fig. 43. Dick's Section; Wilmington T.

1.	Concealed,	30′
2.	*Mercer Upper Coal*,	3′ 6″
3.	Concealed,	15′
4.	*Mercer Lower Limestone*,	4′
5.	Concealed,	10′
6.	*Mercer Lower Coal*, a blossom,	—
		62′ 6″

The "*Four Foot Bed*" (No. 2) is most probably the *Mercer Upper coal* and the same as the upper one mined on the land of Mr. Lyle Mercer. It is here so impure as to be almost worthless, being filled with pyritous slate. It has been mined to a small extent for local use.

The *Mercer Lower limestone* (No. 4) was once burned here, and used as an *hydraulic cement* in building the lock on the Erie and Beaver canal, at Pulaski. The cement is said to have been of excellent quality.

The blossom of the *Lower Mercer coal* is seen 10 feet below the limestone, but it has not been proved.

Shenango.

§ 56. Shenango township stretches along the Lawrence county line, west from Wilmington township, and as far as the Ohio State line.

The Shenango river enters the township near its north-western corner, and, after flowing east along its northern line, passes south nearly through the center.

Along its banks are seen the remnants of once extensive *terraces*, at 20′, 50′, and 120 feet above the bed of the stream.

At an elevation of about 300′ above the water, a wide reach of level country spreads westward, without material change of level, far into Ohio; everywhere covered to an unknown depth with glacial débris; and much of the land is swampy.

The geological rock section exposed in Shenango township extends downward from the Homewood Sandstone into the Cuyahoga Shale.

Shenango township contains the most southern area of the Sharon coal that has ever been found *workable* in Pennsylvania. At the southern limit of the township, near the Lawrence county line, we find a small extent of this coal on the land of Mr. Williams.

At the very north-eastern corner of Shenango township the *Sharon coal* has been mined to a considerable extent in the vicinity of Bethel village, by the Bethel Coal Company.

Bethel Shaft, No. 2, just south of the Mercer and Middlesex road, and 54′ deep, exhibits, according to the report of the superintendent, the following succession:

1. Surface,	20′
2. Shale and Sandstone,	30′
3. *Sharon Coal*,	4′

The most of No. 2 was black slate and sandy shales.

The coal is very irregular, varying from 1½′ to 4′, and frequently disappearing entirely, "horsebacks" coming in and cutting it away. The works are not now in operation, since the small demand for coal does not justify the operators, Curtis & Boyce, in keeping the miners at work; but the pumps are kept going to keep down the water.

The bottom of the Sharon coal lies here, according to the levels of Mr. Walter Pierce, of Sharpsville, 1013′ above tide; showing that there must be a slight dip to the eastward; for at Sharon, 5 miles west of this, the coal bed has an elevation of 1067′ above tide.

One of the miners informs me that on top of the coal at this locality there is found a slaty, bony coal 3″ to 6″ thick; and at the bottom of the bed, frequently, an impure semi-cannel. The main bench is Block coal.

About one mile west from Bethel along the Middlesex road is Bethel shaft No. 1; 89′ deep, and the coal at almost the same level as in No. 2. No record of the shaft could be procured. These works are also now idle.

Just west from Bethel Shaft No. 1 the *Sharon coal* is now mined to a small extent by Mr. Peter Neihossel; by a slope of 45°; for Fannie Furnace at Middlesex; as well as for the use of the neghborhood. The coal varies from 1′ 6″ to 2′ 6″ in thickness, and is a block coal very pure and rich, having alternate laminæ of mineral charcoal and pitchy bitumen.

About one mile east from Middlesex we see the outcrop of the *Sharon coal* along the Mercer road on the land of Mr. Edeburn; 160′ above the level of the E. & P. R. R. at the village and it makes a broad band of smut along the road.

In the south-east part of Shenango township the *Mercer Lower Coal* has been mined to some extent on the land of Mr. Byers; and in a small ravine east from his house I got section Fig. 44.

Fig. 44. Byer's Section; Shenango T.

1.	Concealed from surface down,	20′
2.	Iron ore,	6″ to 1
3.	*Mercer Lower Limestone,*	2′ 6
4.	Shales,	15′
5.	*Mercer Lower Coal,*	1′ 6″ to 2′
		40′ 6″

The iron ore (No. 2) has in former times been mined to a considerable extent for Middlesex Furnaces. It comes in a very persistent layer, and is quite a rich native ore, having averaged (according to report) 45 per cent. of iron.

The *Mercer Lower Limestone* (No. 3) is here seen in two layers (a character which it often exhibits), the upper one 2′ thick and the lower one 6″. There does not appear to be any separating material, not even the thinnest shale, but the layers appear to be in immediate contact, and both are richly fossiliferous; species of *Spirifer*, *Productus* and *Crinoids* being especially numerous. The limestone is of a very dark blue color and breaks with a sharp angular fracture.

The shales (No. 4) are of a dark bluish cast, being interstratified with bands of grey.

The *Mercer Lower coal* (No. 3) has been gouged out of the hill at numerous places along the little stream where Section 44 was obtained. It is also mined by a drift at the roadside. The coal is quite variable both in thickness and quality, sometimes thinning almost entirely away, and again thickening up to 2′ or more. It is a kind of semi-cannel, and occasionally bony; contains a large amount of ash and is only burned when nothing else can be obtained.

The *Mercer Lower ore* (No. 2) was once mined just west from this on the land of Mr. Gerhart and taken to Middlesex. It is reported to have been from 1′ to 1′ 6″ thick, but the old drifts and strippings are so filled up with rubbish that the ore cannot be seen; but the *limestone* appears at its proper horizon,—here about 300′ above the R. R. at Middlesex, or 1133′ above tide.

Near Middlesex a well was once bored for *oil* to the depth of several hundred feet, but none of any consequence was obtained; some gas was struck however at a depth of 200′, as reported to me, but no records of the boring could be obtained, so that very little dependence can be placed in any statements respecting the same.

On the right bank of the Shenango at Middlesex we see

a very fine *Terrace*, 120′ above the level of the stream; covered with Drift, and many rolled bowlders in connection with it.

The *Sharon coal* bed lies in the hills north-west from Middlesex at an elevation of about 980′ (by barometer) above Tide.

Descending from it to the bed of the Shenango at the village I obtained Section Fig. 45, p. 99.

Fig. 45. Middlesex Section; Shenango T.

1.	*Sharon Coal*,	3′
2.	Concealed,	65′
3.	Sandstone, massive, ferriferous (fish),	10′
4.	Flags and Shales, bluish, sandy,	55′
5.	Concealed to level of Shenango,	35′
		168′

Here the Shenango Sandstone (No. 3) is seen in very massive sandstone layers at the top of the bluff along the road which leads west from the village.

It is a yellowish-brown rock, quite coarse, containing many balls of iron ore in close cavities; and many minute fragments of *fish remains*. On one block I saw the cast of a large spine of *Ctenacanthus*.

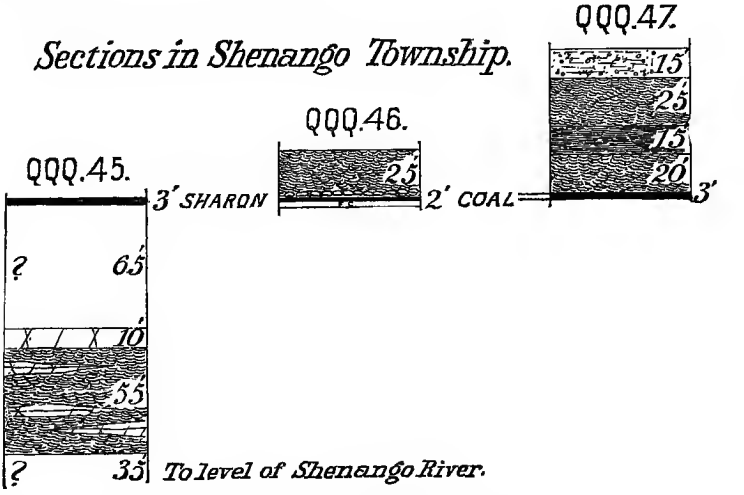
About one mile west from Middlesex and capping the summit of a high knob there is seen a massive bed of sandstone 30′ thick. Its upper surface is planed off smooth and deeply scored by *Glacial striæ* which have a direction nearly south-east. This rock lies 130′ above the level of the *Sharon coal* and is very probably the representative of the *Connoquenessing Upper Sandstone.*

One and a half miles North-west from Middlesex, the *Sharon coal* is now mined by a drift on the land of Mr. Risher; varying in thickness from 0′ to 3′; quite irregular; but its usual thickness about 2′ 6″.

In the hollow just north from here this coal has been mined for a long time, several different companies having

been engaged in the work, the last of which was the Middlesex Furnace Co. The coal is nearly exhausted from this area now, though it originally contained about 30 acres. Toward the west the coal runs out to a feather edge and disappears on a hump of massive sandstone which ranges *nearly north and south.* Half a mile still further west, the coal comes in again, and has been worked by several companies. Whether the barren area separating the two coal fields was caused by erosion, or whether vegetation never grew on it, cannot be satisfactorily determined; but if it is true as reported that the coal in every case thins away to a feather edge, and at no place disappears abruptly, the latter view would seem the true one.

The western strip of coal area is only about half a mile broad; for on its western margin the coal bed again becomes only one foot thick or even less, and is not pursued by the miners any further. *Coal run* drains the northern portion of this coal area, and upon this run are the "Oak Hill" and "Coal Run" slopes, both now inactive, as the workable coal is exhausted.



Near the north-western corner of this township, just at the Ohio State line, the *Sharon coal* is mined by a drift on the land of Mr. Cole.

Here, descending the hill along the road, I obtained the exposed Section, Fig. 46, p. 99.

Fig. 46. Cole's Section; Shenango T.

1. Shales, bluish and black; ore balls,	25′
2. *Sharon Coal*,	2′
3. Fireclay,	3′
	30′

The shales (No. 1) contain a considerable quantity of iron ore in irregular and kidney-shaped masses.

No massive sandstone is seen above the coal; but then the hill rises only a short distance above No. 1.

The *Sharon Coal* (No. 2) is here mined on a small scale to supply the neighborhood. It is exceedingly variable; in certain directions running out entirely. The coal is quite good, being to the eye free from pyrites. It lies here about 150′ above the level of the E. & P. R. R., at Middlesex.

About one mile east from the Ohio State line, and one and a half miles south from the north township line, is the Mt. Morris Coal shaft, 75′ deep; and, according to the testimony of a man who helped to sink it, showing the following Section, Fig. 47, p. 99.

Fig. 47. Mt. Morris Shaft; Shenango T.

1. Drift,	15′
2. Shales, gray, sandy,	25′
3. Slate, dark,	15′
4. Shales, gray, sandy,	20′
5. *Sharon Coal*,	3′
	78′

A large amount of coal has been taken out of this shaft; but the workable area is exhausted and the works abandoned.

Three-fourths of a mile south-east from the Mt. Morris shaft are the Crawford coal works; shaft 120′ deep; coal

mined out; works abandoned, and nothing to be learned about the strata passed through.

About one mile north from this the coal is mined by a slope on the land of Mr. McCreary; 20′ beneath the surface; 2′ to 3′ 6″ thick. There are only about five acres of coal left in this area, which is a remnant of the old Berlin mines, once extensively worked.

A very massive sandstone, lying 40′ above the coal bed, has been quarried just south of the McCreary slope; twenty feet of the rock exposed; a very fine building stone; a beautiful grayish-white rock, splitting quite freely.

Near the southern line of Shenango township, and about one mile and a half east from the Ohio line, is a small workable area of the *Sharon coal* on the land of Mr. Williams, who mines it by a drift. It extends south to the very edge of Lawrence county, but seems there to become too thin to work. In the Williams mine it varies in thickness from a few inches up to 2′ 6″.

This is the most southern point in Pennsylvania at which the *Sharon coal* has been found in workable condition; and at this, its final outcrop to the south, it seems to hold more ash than usual, as shown by the following analysis by Mr. McCreath:

Water,	3.790
Volatile matter,	35.300
Fixed carbon,	53.875
Sulphur,	.675
Ash,	6.360
Total,	100.000
Coke, per cent.,	60.910
Color of ash,	Gray.

The hills rise above the coal about 150′, covered with the débris of the *Connoquenessing Sandstones.*

A short distance north from this the smut of the *Sharon coal* is seen along the road, in a very small black streak; the bed is probably not workable.

Going still further north to the cross-roads at Mr. Bentley's, and turning west, we see the *Connoquenessing Lower*

Sandstone forming a very massive cliff along the road, 20′ high. The rock is very hard and white, and has been quarried to some extent. Borings for the *Sharon coal* in this vicinity show it to be present, but only 1′ to 1′ 6″ thick.

From the foregoing details it will be readily seen that the *Sharon coal* remaining in this township is of very insignificant amount, for nearly all the known areas have been mined out. It is barely possible that other areas may be discovered by the drill; but they will necessarily be of limited extent.

Hickory.

§ *57.* Hickory township borders on the State of Ohio, north of Shenango township.

The Shenango flows in a winding channel along its western line, while all its eastern and central parts constitute a high broad table-land, planed off to a nearly uniform level by glacial action.

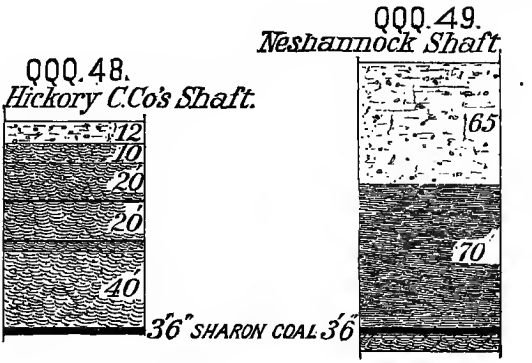
The section of exposed rocks measures 435′, from the top of the *Conglomerate series* down to 200′ below the *Sharon coal.*

The city of Sharon, from which the famous block coal bed received its name, is in Hickory township, which, in fact, contains all the workable areas of it of any importance now to be found east of the Ohio State line,—areas from which has already been mined many millions of tons. In fact, so very large has been the production, that the larger portion has been worked out; and probably twenty years more of equally rapid mining will entirely exhaust it; unless, indeed, the drill should discover unexpected extensions of the area.

Commencing with the south-eastern corner of Hickory township, not far north of Bethel, the Sharon coal is mined by the Hickory Coal Company; by a shaft 107′ deep; through the following strata; Fig. 48, p. 103:

Fig. 48. Hickory Coal Co. Shaft; Hickory T.

1. Drift,	12′	
2. Shales, sandy,	10′	
3. Shales, dark,	20′	
4. *Coal*, a rider,		3′
5. Shales, dark,	20′	
6. *Coal*, a rider,		11″
7. Shales, dark,	5′	
8. Shales, gray, sandy,	40′	
9. *Sharon Coal*,	3′	6″
	121′	9″



The thin coal beds, Nos. 4 and 6, are what the miners call *riders;* not representing any persistent coal horizon, but merely local streaks of coal in one shaft, not necessarily to be found in any other, even if only a short distance away. In fact, at the Bethel shaft, only a short distance south from this, no *riders* were reported.

These riders used to be mistaken for the Sharon coal itself. Hence Professor Rogers has placed one or two coal beds in the series *beneath the Sharon Coal*, in his Geol. Penn., 1858. No bed of coal has ever, to my knowledge, been seen below the true Sharon bed (No. 9 of the above section.)

The *Sharon over-shales*, (No. 8,) are often converted into a *massive sandstone*, which then rests immediately upon the coal; and the miners agree in affirming that the coal is always of a poorer quality, containing much more sulphur when the roof is a sandstone than when it is shale.

Sulphur deposited from above.—From this it would appear that a portion of the sulphur found in our coals may be due to percolation from above. Coarse sandstone readily permits the passage of waters, while a bed of shale would stop it. I have often noted the same fact with other coals than the Sharon, and do not remember to have ever seen a very pure coal which was immediately covered by a porous sandstone.

The *Sharon coal bed* (No. 9) is quite variable in thickness at this locality; the floor of the mine exceedingly uneven, rising and falling in *hills* and *swamps*, the coal thinning away to 6 inches or even less on the *hills*, and thickening up to 3½ feet in the *swamps;* and the difference of level between the tops of the *hills* and the bottoms of the *swamps* often being as much as 25 feet.

This Hickory Coal Company ships about 50 tons daily; that from under the slate roof being used as a furnace coal; that from under the sandstone roof for steam and domestic purposes.

The yield of the mine is an excellent type of the "Block" variety of coal, so justly celebrated.

Here very hard white sandstone lies immediately below the coal, (*the Sharon Conglomerate.*)

North from this, and in the neighborhood of the village of Neshannock, several shafts have been sunk to the *Sharon Coal* by the Neshannock Coal Company and others; but the mines are now nearly all worked out, and the shafts abandoned.

Three fourths of a mile northeast from Neshannock, and near the east line of Hickory, is the Neshannock Shaft No. 2, of which the superintendent gave me the following record: Fig. 49, p. 103, above.

Fig. 49. Neshannock Shaft No. 2; Hickory T.

1. Drift,	65′
2. Slate, dark,	70′
3. Slate, gray,	6′
4. *Sharon Coal,*	3′ 6″

5. Fireclay,	8″
6. Sandstone,	2′
7. Shales, sandy,	7′
	132′ 2″

We here reach the eastern edge of the *Sharon coal basin;* for from this mine the coal thins away eastward and disappears entirely.

The superficial covering of *Drift* is here quite deep, extending from the surface down to within 16′ of the coal; and percolating waters have carried down the fine clay found in the Drift and spread it as a thin coating over the blocks of coal, giving them a grayish-white appearance. At one point, a little west from the shaft, the *Drift* is deep enough to reach below the level of the coal, and cuts it out.

Shipped to Sharpsville Furnaces, the coal is used raw, and shows itself to be of excellent quality.

Mercer Lower Coal?—About one mile north from this, and near the German Reformed Church, at the cross roads, Mr. Seems, in digging a well, passed through a bed of coal 1′ 6″ thick, 30′ beneath the surface, and 150′ above the horizon of the *Sharon Coal.* It probably represents the Lower Mercer. Nothing was seen of the accompanying *limestone*, for the *Drift* covering extended quite down to the coal.

Near the northeast corner of Hickory township there occurs an area of the *Sharon coal* on the land of Mr. Rapp. It was extensively mined here about 25 years ago, by Messrs. Trimble and Clark, of Mercer, and shipped by tramroad to the old Beaver and Erie canal, which passes along the valley of the Shenango, 1½ miles north from here.

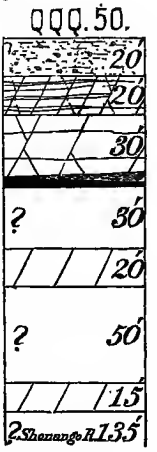
The bed varied in thickness from 2′ 6″ to 4′, and often thinned entirely away. The larger part of this coal basin has long since been worked out; but there is a small amount remaining, which is mined by a slope for country supply.

The coal lies 20′ beneath the surface, at the mouth of the slope; about 1150′ (barometer) above tide.

One mile west from here the *Sharon coal* has been mined to some extent on the land of Mr. Hahn, and here we obtain the following succession in descending from Mr. Hahn's slope to the Shenango, at the north: See Fig. 50.

Fig. 50. Hahn's Slope Section; Hickory T.

1.	Soil and Drift,	20′
2.	Sandstone, shaly,	20′
3.	Sandstone, massive,	30′
4.	Shales,	0′ to 5′
5.	*Sharon Coal*,	2′ to 4′
6.	Concealed,	30′
7.	Sandstone, massive,	20′
8.	Concealed,	50′
9.	Sandstone, massive,	15′
10.	Concealed to Shenango river,	135
		329′



Mr. Hahn has a slope to the coal at this point, and is mining out some of the coal left by the old company which formerly operated and shipped it on the canal. The coal is as usual quite variable in thickness, and often thins away to almost nothing.

The shaly and massive sandstones (Nos. 2 and 3) represent the *Connoquenessing Lower Sandstone;* and the lower part of No. 3 is quite pebbly; but the pebbles are not larger than a pea. It is a very coarse, hard rock, with much false bedding.

The massive sandstone (No. 7) is the representative of the *Sharon Conglomerate*, often found beneath the Sharon coal; it does not exhibit a conglomerate character, but is tolerably coarse-grained, of a grayish-white color, and an excellent building stone. It was once quarried here extensively for the canal locks. It resists the weather wonderfully, for blocks placed in the canal locks forty years ago are as clean and sharply cut as though they had but just left the quarry.

The *Shenango Sandstone* (No. 9) is a brownish-yellow coarse-grained sandstone, containing many balls of iron ore varying in size from an inch to three inches in diameter. On account of the persistency of this peculiarity over large areas, I became accustomed to calling it the Ferriferous Sandstone until it became desirable to adopt another and more precise geographical name. It also has been quarried here. I observed in it some *fish remains*, consisting of scales, teeth, fragments of bones, &c.

Still further west from Mr. Hahn's, and a short distance east from Hickory Corners, we come to another area of the *Sharon coal*, on what is known as the Ormsby estate. A very large amount of coal has been mined from this land, and there is very little remaining.

By far the largest continuous area of *Sharon coal* was found on the property adjoining on the south, known as the Pierce estate. From this many hundred thousand tons of coal have been mined. Mr. Ullrich has a slope to the coal, now, where he is mining it for local supply. The bed lies 25′ beneath the surface, and is only 2′ thick in the present headings, but a large portion of the tract had it from 3′ to 4′ thick.

Just south from Gen. Pierce's estate, and near the central line of the township, and on the land of Mr. Hoagland, is a high knob called "Keel Ridge," rising far above the surrounding hills to an elevation of 1275′ above tide. It is topped by a broad sheet of the *Homewood Sandstone*, which has preserved it from the eroding agencies which have leveled off everything else far and wide around. Its identity is proved by the presence of the *Mercer Lower Limestone* immediately below it.

Mr. Hoagland once drilled in search of the *Sharon coal*, commencing on the very summit of the Knob, and I obtained from the driller the following record, Fig. 51, p. 109:

Fig. 51. Hoagland's bore hole; Hickory T.

1.	Homewood Sandstone, massive,	68′
2.	Fireclay,	3′
3.	Iron ore,	1′ 6″
4.	*Mercer Lower Limestone*,	4′
5.	*Mercer Lower Coal*,	1′ 6″
6.	Slate, black and gray,	70′
7.	*Coal*,	1′ 6″
8.	Slate,	20′
9.	Sandstone and slate to bottom of hole,	66′
		235′ 6″

The *Homewood Sandstone* (No. 1) extends to the very summit of the Knob, and was probably once much thicker; for its upper surface is planed off and deeply striated with *Glacial markings*, whose general direction is south 20°east, magnetic.

It has been extensively quarried for building stone, at the eastern end of the Ridge near the public road. It is a very coarse brownish-gray rock; often of a buffish cast; massive throughout; splitting readily into blocks of any desired size.

Where the outcrop of sandstone comes into the public road it exhibits *glacial scratches;* a proof that the Northern Ice flowed over land now nearly 1300′ above sea level. How much of the previously higher surface it removed cannot be known.*

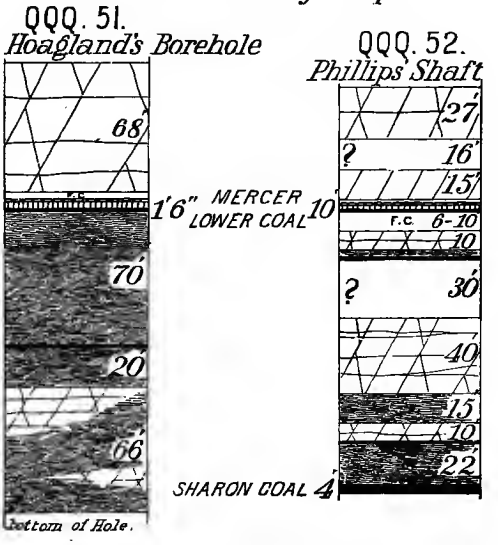
The *iron ore* (No. 3) which almost universally accompanies the *Mercer Lower Limestone* in Lawrence county, seems to be equally persistent in Mercer. It may therefore be called the *Mercer Lower Limestone ore.*

It is well exposed at an old drift, just below Mr. Hoagland's house, made for the ore and limestone below it. The ore is 1′ thick and rich, containing probably 50 per cent.

* The erosion to which this part of the State has been subjected may be estimated from the fact that the plane of the Pittsburgh Coal bed, if projected northward over Mercer county, would pass at a height of 900′ above the top of "*Keel Ridge*," since that many feet of strata are found intervening between the Pittsburgh coal and the top of the Homewood sandstone, so that the reader can readily see what an enormous quantity of rock material has been worn away from the hills of Mercer county by the action of water in its various forms.

of metallic iron. At the outcrop it is brown hematite; but further back in the hill carbonate. Just below it lie large deposits of *bog ore* in front of springs along the southwest side of the hill, and give name to the hill. At some points 3′ to 4′ of "Keel" or *bog ore* have been deposited, and were once extensively mined for the Sharpsville furnaces, as well as for the old Clay furnace, a few miles east, in Lackawannock township. At the ore mines the spring which made the surrounding deposit still continues to flow; but on the western side of the hill where another large deposit was found, no spring is now to be seen, the water having found some new channel by which to reach the surface.

Sections in Hickory Twp.



Many parts of the ore bed itself are full of fossils, showing that it has been formed by waters percolating from above, upon and into the limestone, dissolving out and replacing the lime with iron.

The presence of the *Mercer Lower Limestone*, (No. 4 of the section,) here so far away from any other locality where it is found, shows the former universality of its distribution in Mercer county. But I identify it with the *Lower*

of the two Mercer Limestones because I have found this stratum more persistent than the *Upper*, whose usual place is 25′ to 30′ above it; and because iron ore more frequently accompanies the lower one. Whichever it be, it is here filled with *fossil mollusks*, and *crinoidal* fragments; and I noticed also many specimens of *coral*. At the mouth of the entry, where it has been quarried, the lime rock is 3′ thick; of a light grayish-blue color; very compact; and breaking with a sharp irregular fracture. It has been burned for agricultural purposes, making a strong lime. It was also once used as a flux at the Sharpsville furnaces, as well as at the Clay furnace.

The *Mercer Lower? Coal* (No. 5) is here reported by the drillers to be 1′ 6″ thick; but at the entry it shows only one foot of bony impure semi-cannel, and is of no economic importance.

(No. 7) should represent the *Quakertown Coal;* at least this is the horizon at which that coal often occurs.

The drillers gave up the attempt to find the *Sharon coal* at a depth of 159′ beneath the *Mercer Lower Limestone.* But as I have never known the interval *to be less than 160′*, and have often seen it more than 200′, this drill hole ought not to be considered as definitely determining the presence or absence of this important bed. From other considerations, however, it is extremely improbable that they would have found any *workable* Sharon coal here, even had the hole been drilled to a greater depth; for the bed has been mined on nearly every side of Keel Ridge, and it has been found to *thin away toward it* from every direction.

Half a mile west from the outcrop of the limestone in Keel Ridge, the *Sharon coal* was once mined by a shaft, 50′ deep, on the land of Mr. Phillips. The mouth of the shaft is 110′ below the level of the limestone, and this added to the 50′ in the shaft, makes the leveled interval between the two strata 160′; but as the dip is eastward, the geological interval ought to be a few feet more.

Mr. Lewis, of Pardoe, made a leveled section from near the top of Keel Ridge down to the Sharon coal, and kindly placed the same at my disposal; Fig. 52, p. 109:

Fig. 52. Phillips' Shaft Section; Hickory T.

1. Sandstone, massive,	27′	
2. Concealed,	16′	
3. Sandstone, massive,	15′	
4. Fireclay,	1′	6″
5. Iron ore,		10″
6. *Mercer Lower Limestone*,	3′	
7. *Mercer Lower Coal*,		10″
8. Fireclay,	6′ to 10′	
9. Sandstone,	10′	
10. Black slate, 3′ 6′ 11. *Coal*, (local?) 2′	5′	6″
12. Concealed,	30′	
13. Sandstone,	40′	
14. Slate, black and gray,	15′	
15. Sandstone,	10′	
16. *Coal*, (a rider,)		9″
17. Black slate,	22′	
18. *Sharon Coal*,	4′	
	225′	11″

This section was made by connecting the surface exposures with a shaft about ¾ mile away to the north, so that the interval between the *Mercer Lower coal* and limestone and the *Sharon coal* is about 20 feet less than it should be in a vertical measurement.

The coal bed (No. 11) seems to be a new or rather a local element in the series, as I have not seen it before at this horizon.

The coal bed (No. 16) is one of the thin local *riders* over the Sharon coal, already described.

One and a half miles south from this we come to the Oakland coal works, operated by Pierce & Scott, and the series of strata passed through at Oakland, No. 1, is shown in the following Section, Fig. 53, p. 112:

Fig. 53. Oakland Coal Works; Hickory T.

1. Drift,	90′	
2. Shale, soft, gray,	38′	
3. Black slate,	2′	
4. *Sharon coal*,	4′	6″
	134′	6″

Here the coal lies about 1000′ above tide. It is of excellent quality and has been shipped extensively. At one part of the workings the coal was found to be cut away, and the cut-out filled with *Glacial drift.* An entry at Oakland No. 1, proved the cut-out to be 100 yards in width. Its general course is south 30° east (Mag.), and it widens from 100 yards at Oakland, No. 1, to 400 yards one half mile south. The depth of this old channel is unknown, for no holes have ever been bored through it. In searching for the coal Mr. Wise struck the cut out, and drilled in it 40′ below the level of the Sharon coal without coming to its bottom.

The coal is now exhausted from Oakland No. 1.

A short distance south from Oakland No. 1, we come to a shaft, Oakland No. 3, lately sunk by Pierce & Scott. Through the kindness of Mr. Pierce I was permitted to make the following Section in the shaft, Fig. 54:

Fig. 54. Oakland Shaft, No. 3; Hickory T.

1. Drift,	20′
2. Shale, gray,	50′
3. Sandstone, very hard,	18′
4. Shale, gray,	14′
5. Sandstone, hard, white,	30′
6. *Sharon coal,*	4′
	136′

The very white hard sandstone (No. 5) lies in immediate contact over the *Sharon coal;* hence, the latter is subject to great variations, thickening sometimes to 5 feet and thinning to one foot; having evidently been cut away by the current which threw down the sand; for we often see strings and *fragments of coal scattered through the base of the sandstone.*

The coal is very black and shining, but, as usual when with a sandstone roof, contains too much sulphur for furnace use. Running through many of the seams we find thin plates of silica; and also minute crystals of quartz. The coal clinkers on the fire.

Mr. Wise, an experienced driller, made several borings

in the vicinity of Oakland No. 3, the records of which he has kindly placed at my disposal. It is interesting to compare them with one another, as they show *marked changes in the strata within short distances.* See Figs. 55, 56, 57, and 58.

Fig. 55 represents a hole a few rods from Shaft No. 3.

Fig. 56, another in the same vicinity.

Fig. 57, one bored only 25 feet south west of the Shaft.

Fig. 58, a fourth bored 500 feet north of the Shaft.

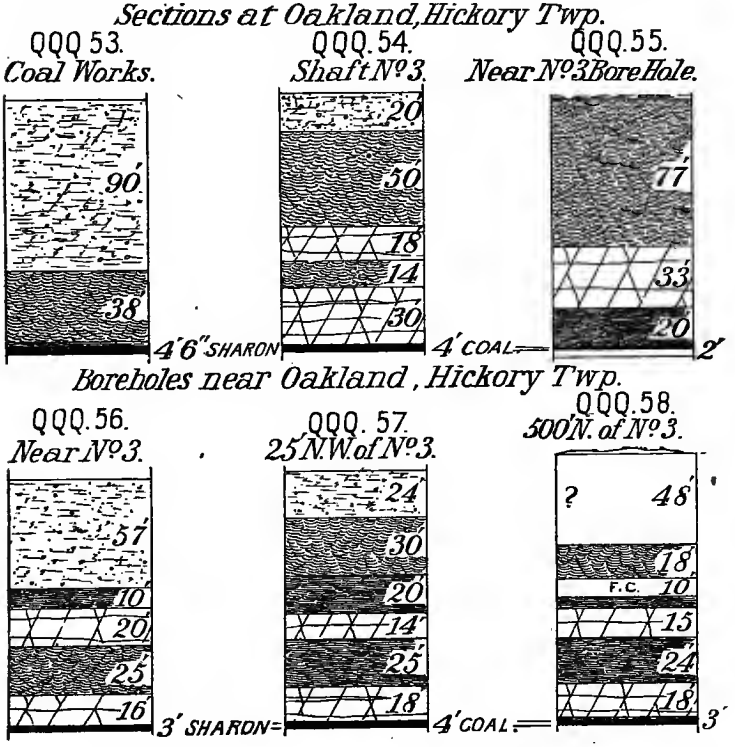


Fig. 55.

1. *Drift,*	77′
2. Shale, gray,	33′
3. Sandstone,	20
4. Black slate,	2′
5. *Sharon Coal,*	4′
	136

Fig. 56.

1. *Drift,*	57′
2. Slate, gray,	10′
3. Sandstone,	20′
4. Shale, gray,	25′
5. Sandstone,	16′
6. *Sharon Coal,*	3′
	131′

Fig. 57.

1. *Drift*,	24′
2. Shale, gray,	30′
3. Slate, black,	20′
4. Sandstone,	14′
5. Slate, black,	25′
6. Sandstone,	18′
7. *Sharon Coal*,	4′
	135′

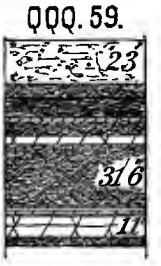
Fig. 58.

1. (From surface down to),	48′
2. Shale, gray,	18′
3. Fireclay,	10′
4. Slate, black,	6′
5. Sandstone, soft,	15′
6. Slate, black,	24′
7. Sandstone, hard,	18′
8. Slate, black,	1′
9. *Sharon Coal*,	3′
	143′

Three fourths of a mile south from Oakland No. 3 Mr. Wise also drilled a hole which gave him the following record, Section and Fig. 59:

Fig. 59. Borehole, ¾ mile S. of Oakland No. 3; Hickory T.

1. *Drift*,	23′	
2. Shale,	7′	
3. *Coal*, (*Quakertown Coal?*)		10″
4. Slate,	9′	
5. Slate, black,	1′	
6. Sandstone,	2′	
7. Shale, gray,	7′	
8. Sandstone,	5′	
9. Shale, gray,	31′	6″
10. Sandstone,	1′	6″
11. Shale, light gray,	1′	6″
12. Sandstone,	2′	
13. Shale, gray,	1′	
14. Sandstone, brown,	11′	
15. Sandstone, very white,	4′	6″
16. Shale, bluish, "Bottom of hole,"	—	
	107′	10″



(No. 3) of this section is possibly the *Quakertown coal.*

No representative of the *Sharon coal* was found in this boring. Its place would be immediately below (No. 15) where instead of coal appear those bluish-white shales (No. 16) which the drillers every where term "bottoms," on striking which they give up all hope of coal. Some of the drillers prefer to use the term "soapstone."

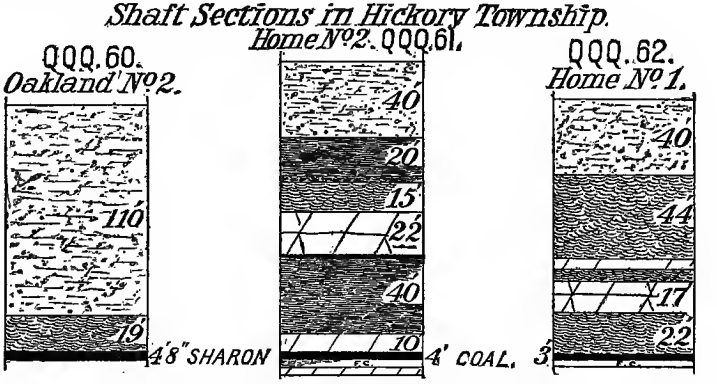
About three fourths of a mile southeast from Oakland shaft No. 3, we come to the Five Points coal works, or

Oakland shaft No. 2, the record of which reads as follows: Fig. 60.

Fig. 60. Oakland Shaft, No. 2; Hickory T.

1.	*Drift*, glacial,	110′
2.	Shale, gray,	19′
3.	Sharon Coal,	4′ 8″
		133′ 8″

Here we find *a great depth of Glacial Drift;* and, just on the eastern edge of this mine, the coal is cut away, as at Oakland No. 3. The buried channel extends from the one shaft to the other, the coal having been mined continuously along both sides of the cut-out. How much further south this extends is not known; for the coal thins out in that direction.



Mr. Pierce informs me that in sinking this shaft *a granite bowlder four feet in diameter was struck at a depth of fifty feet;* that he has encountered large granite bowlders from top to bottom of the Drift; and that he found a very large bowlder in Oakland No. 1, about 60′ beneath the surface. It may possibly be, therefore, that the large so-called *Erratics* which are now found on the surface of the country may have been transported along with the true Drift, and been subsequently carried further south than the Glacial sheet extended.

The *Drift* in Oakland No. 2, was made up of small bowlders of every description, mingled with clay of a

creamy white, or bluish white color; but in some places the clay was almost free from bowlders.

The coal from this mine is quite pure, and of the Block type. It varies in thickness from 0′ to 4′; is quite irregular, and often thins entirely away.

About one quarter of a mile west from Oakland Shaft No. 3, we come to Home Shaft No. 2, operated by Buhl, Westerman & Co. of Sharon, and the record of this shaft is shown in Section, Fig. 61.

Fig. 61. Home Shaft, No. 2; Hickory T.

1.	*Drift*,	40′
2.	Slate, black,	20′
3.	Shale, light drab,	3′
4.	Shale, darkish,	15′
5.	Sandstone, massive,	22′
6.	*Coal*, (rider,)	6″
7.	Slate, black,	40′
8.	Sandstone, massive,	10′
9.	*Sharon Coal*,	4′
10.	Fireclay and shales,	4′
11.	Sandstone, massive, (*Sharon Conglomerate*,)	4′
		152′ 6″

(No. 6) is one of those thin coal seams which may appear anywhere in the shales above the *Sharon Coal*, and disappear as quickly. The miners term them "riders," and usually interpret their presence in a boring as a sure indicator that the "Block" coal will be found at its proper place below.

(No. 8) is a very massive white quartzose rock, and lies in direct contact upon the coal bed, subjecting it to great variations.

This sandstone keeps this position with reference to the coal throughout a considerable area here, and the field was once abandoned as barren territory, since it was supposed that this (No. 8) sandstone was the *Sharon Conglomerate*, (No. 11) beneath the coal, until Mr. Pierce of Sharpsville, skeptical of this opinion, drilled through the rock and found four feet of good coal over a considerable area.*

* Experience is every day confirming the opinion of such men as Mr. Pierce that it is better to be certain that the coal is not present before giving up the

The *Sharon Coal* at Home Shaft No. 2 is quite black and shiny, but contains rather too much sulphur for smelting iron; though in some portions of the bank the sulphur is mostly concentrated into huge "binders, which can be readily separated, leaving the coal quite pure.

(Nos. 10 and 11) are seen in the well from which the water is pumped.

About one half mile west from this we come to Home shaft No. 1, operated by the same company, of which the superintendent gave me the following record, Fig. 62:

Fig. 62. Home Shaft No. 1; Hickory T.

1. *Drift*,	40′
2. Shale, sandy, grayish,	44′
3. Sandstone,	6′
4. Shale, black,	6′
5. Sandstone, coarse, white,	17′
6. Shale, grayish,	22′
7. *Sharon Coal*,	3′
8. Fireclay,	3′
	141′

The coal is quite irregular thickening up in the *swamps* and thinning away on the *hills*.

The superintendent, who drove the long tunnel for the Brookfield Coal Co. near Sharon, states that *sandstone underlies the coal on the hills, and blue shale underlies it in the swamps*.

He states also that the highest point reached by the coal in this mine is 40 feet above the lowest of the swamps. The dip is north-westerly for some distance, changing then to a rise in that direction. The bottom of the mine is quite uneven and rolling. The coal is excellent and is shipped at the rate of 150 tons per day, by way of the Sharpsville and E. & P. R. R. to Erie.

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drill hole; for instance, it often happens that a bed of shale is found above the coal so closely resembling those usually found below, that numerous cases are on record where experienced drillers have given up and termed it "bottom," when years afterwards some doubter has drilled the same hole deeper and found a good bed of coal.

The Sharpsville R. R. is the outlet for all the coal mined in the central and western portions of Hickory township.

About one mile east from Sharon the coal is mined by Dunnham, Roberts & Co. at their Pacific Slope; about four feet thick and of excellent quality; being used at the Kimberly Mills and Furnace in Sharon. It is transported down the hill in carts.

A short distance south from the Pacific Slope the coal is mined chiefly for domestic use, by an entry on the Sharon and Mercer road; Mr. Bombeck owner. Only a small area of it remains.

Just north from the mouth of the Bombeck drift there is a *stone quarry* on the land of Mr. McClary. The rock here quarried lies immediately above the Sharon coal, and is very much twisted and false-bedded. It is a grayish white rock and quite massive; twelve feet of it exposed.

On the road leading south from Bombeck's entry the *Sharon coal* was once mined by Curtis and Boyce, but the mines are now exhausted and abandoned.

Further south and near Hoffman's cross-roads the *Sharon coal* is now mined by a slope on the land of Hoffman & Company; 40′ beneath the surface; and 30′ lower than at the Bombeck entry.

At Sharpsville we see a wide and beautiful *Terrace of Glacial Drift*, at an elevation of from 100′ to 120′ above the level of the Shenango. It is of wide extent and stretches for a long distance south towards Sharon. At Sharpsville Mr. Kitch sunk a well 63 feet through the deposit without finding solid rock. A *granite bowlder* weighing several hundred pounds was encountered *at a depth of 30 feet.*

About one and a half miles below Sharpsville we come to the Sharon Furnace, of Boyce, Rawle & Company.

A *deep well* for gas and oil was drilled, in 1876, by the company, half a mile east of the river, on the little run

which here puts into the Shenango; and the following is a copy of their well record, Fig. 63:

Fig. 63. Sharon Furnace Oil Well; Hickory T.

0. Surface.
(57′ above the level of the Shenango,) . . 0′

1. Drift, ("Clay, gravel and bowlders,") . . . 100′

2. Shale, ("Soapstone,") ("A little gas at 115′,") 85′

3. Sandstone, ("White, sharp sandstone,") . . 75′

4. Shale.
("Light-blue shale.")
("Gas at 485′,") . . . . . 305′

5. Sandstone.
("Fine gray sand,") . . . . . 30′

6. Shales.
("A succession of blue, gray, and brown shales, interspersed with thin layers of fine grit.")
("Show of oil and gas at 618′ from the mouth of the well.") . . . . . 1005′

Total depth of well by addition, ... 1600′

The bottom of the *Glacial Drift* (No. 1) lies 43′ beneath the present level of the Shenango, where the borehole was located; but had it been located at some point nearer the present river channel it is probable that a greater depth of Drift material would have been found.

The white sandstone (No. 3) is the equivalent of that reservoir of salt water, the 124′ sandstone, of the deep well at Beaver Falls. It is also the oil rock of the Mahoning river valley in Lawrence county, and of the Little Beaver valley at Smith's Ferry, &c. Here, however (at Sharon Furnace) it seems to be too fine-grained to serve as a reservoir for oil.

The fine gray sandstone (No. 5) corresponds to a rock of the same thickness struck in the Beaver Falls well, and represents one of the lower oil sands of Butler county.

The rest of the boring passed through fine shales with very little variety of composition; and no sands of any kind were found below (No. 5); so that it may be considered settled that there are no good oil sands in this region below that horizon; and in fact the 75′ rock (No. 3) is the only one ever likely to yield oil in paying quantities.

At Sharon the coal has been extensively mined just across the line in Ohio, opposite the Westerman Iron Works, and here, descending to the Shenango, we get the following Section, Fig. 64:

Fig. 64. Westerman Iron Works Section; Hickory T.

1.	*Sharon Coal*,	4′
2.	Fireclay and shales,	3′ to 4′
3.	SHARON CONGLOMERATE,	15′
4.	Concealed,	150′
5.	*Sharpsville Sandstone*, flaggy,	50′
6.	Shales, bluish, to level of Shenango,	5′
		213′

(No. 3) here quite pebbly,—a regular conglomerate—makes its appearance below the coal along the road just at the Ohio line. It is the first time in the course of this report on Hickory township that we have seen a *conglomerate below the Sharon Coal.*

In the country lying east of the Shenango, a massive white sandstone is often found immediately below the coal; but no conglomerate; and frequently no sandstone; the coal resting immediately upon those shaly top-flags of the Cuyahoga Formation, the drillers' "bottom."

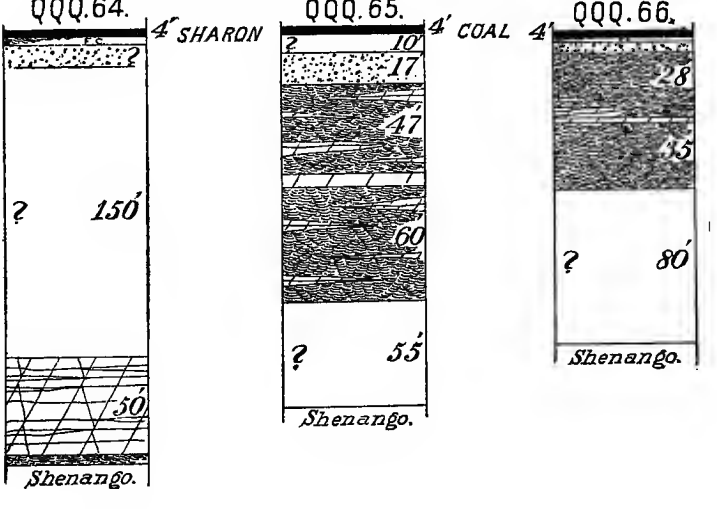
On the other hand, as we go west, into Ohio, the conglomerate is found below the coal for several miles.

(No. 5) if it represents the Berea Grit, is a rock of quite a different composition from the one exposed in the quarries of Berea, where the upper 30′ of the formation is somewhat flaggy, but the lower 45′ is quite massive. Here at Sharon, on the contrary, the stratum consists of alternate layers of fine-grained sandstone, 1′ to 2′ thick, and of shale the layers of which are from 6″ to 1′. The rock is quarried above the Westerman Iron Works, on the land of Mr. Taylor, and some of the layers make a very excellent building stone.

(No. 6) is a bluish, very argillaceous shale, which contains considerable iron, thus causing it to weather to a rusty color on exposure.

The *Sharon coal* has here, according to Mr. Chance, an elevation of 1068 feet above tide.

Sections in Hickory Township.



About 2½ miles south-west from Sharon, in Ohio, the coal is extensively mined by the Brookfield company. As the rock exposures along a little stream which puts into Big Yankee run are very good, I will give the section here for reference and comparison. Passing down the run from the coal slope past Whittaker's Falls the section is as follows:

Fig. 65. Whittaker Falls Section; Hickory T.

1.	*Sharon Coal*,	4′
2.	Concealed,	10′
3.	*Sharon Conglomerate*,	17′
4.	Sandstone, flaggy; sandy shale,	47′
5.	*Shenango* sandstone, massive, ferriferous,	7′
6.	Shales, bluish; flaggy sandstone,	60′
7.	Concealed to level of Shenango,	55′
		203′

The Sharon Conglomerate, (No. 3) is very finely exposed at this locality, and forms a conspicuous cliff around the hill. It is composed of two distinctly different rocks, though they are in immediate contact. The upper half of the stratum is a fine-grained sandstone of almost snowy whiteness; the lower half is a genuine conglomerate, being composed largely of quartz pebbles loosely cemented together in a matrix of coarse grayish-brown sand. The pebbles are mostly angular, ranging in size from a pea to a hickory nut; most of them are ovoid, but occasionally we see some that are flattened.

The upper surface of No. 3 here forms the surface rock, and its top is planed off perfectly smooth and striated by glacial action; scratches and grooves running nearly south.

The *Shenango Sandstone*, (No. 5,) is here, as elsewhere, characterized by containing many balls of iron ore, and frequently many *fish* remains. It makes a rather coarse brownish rock, and has been quarried to some extent for quite a fair building stone when the ore balls are not too numerous.

To show the variation in this series of rocks, I will give, for comparison with the last section, another, (Fig. 66,) obtained in the Brookfield tunnel, which cuts the same meas-

ures half a mile west from here. When I visited this locality in 1876 the tunnel was not yet completed, but it has since that time been finished, and I can now give the entire section.*

Fig. 66. Brookfield Tunnel Section; Hickory T.

1.	*Sharon Coal*,	4′
2.	Fireclay and shales,	2′
3.	*Sharon Conglomerate*,	6′
4.	Shales, bluish, sandy,	28′
5.	Sandstones, shaly,	6′
6.	Sandstone, hard, quartzose (with fish, shells, and plants),	3′
7.	Shales, bluish, sandy,	35′
8.	Concealed to Shenango,	80′
		164′

The Brookfield Coal Company's works are among the most extensive in the Shenango valley, having about ten miles of under-ground track, or car roads.

I was conducted through several miles of these entries from which the coal has been mined, and thus had a fine opportunity of seeing and studying the peculiarities of this remarkable *Sharon coal.*

The roof is a black shale which is perfectly frescoed with plant remains; graceful ferns, the long ribbon-like *Cordaites*, and the elegantly cicatriced *Lepidodendra* and *Sigillariæ* being equally abundant.

Below the coal we find one to two feet of fireclay, which rests immediately upon the mass of pebbles, or conglomerate below.

The floor of the coal is most uneven, being constantly elevated and depressed by the "hills" and "swamps" of the miners. The coal is 4 to 5 feet thick in the "swamps," but rapidly thins away to almost nothing on the "hills."

The "hills" are nothing but *piles of conglomerate, which often rise at an angle of 15°* to a height of 20 to 30 feet, and the "swamps" are depressions in the same pebble bed probably formed by erosion anterior to the spread of the coal marsh over the broken and uneven surface that remained.

* See Report QQ, page 296.

Thus at the lowest depression in the mine, which is the point where the upper end of the tunnel commences, the pebble rock below the coal is only 6 feet thick, while on the "hills," and at the outcrop of the rock, it is 20 to 25 feet.

The *Sharon Conglomerate* (No. 3) has thinned down from 17′ in the previous section to only 6′ in this.

The *Shenango Sandstone* (No. 6) has thinned from 7′ to 3′, and in this tunnel section is not only as hard as granite, but a perfect mass of *fish*, *shell* and *plant remains*. It also contains many rounded pebbles of sandstone and shale, as well as some occasional iron balls. Some of the bones are an inch in diameter, indicating a fish of large size.

The plant remains are fragments of the small *Lepidodendron Veltheimianum.*

The shell remains are of sub-carboniferous forms—*Productus*, *Orthis* and *Straparollus.*

The miners had a terrible time in getting through this stratum, which is more like a quartzite than a sandstone; and as the rate of dip is only 2 feet in the hundred, they were compelled to cut through it for a long distance. The tunnel runs due west until it strikes the coal.

(No. 8) is a bluish sandy shale, near the middle of which is a layer which is a perfect mass of shells—*Productus*, *Allorisma* and *Spirifer* especially numerous. *Fucoids* are also numerous in the shale.

As we pass up the Shenango from Sharon the stream rises faster than the rock strata, so that we have the so-called *Berea Grit* forming a sharp steep bluff all the way up the right bank of the stream to and beyond Sharpsville. At Sharpsville it has been quarried to a considerable extent on the right bank; somewhat flaggy; but a close fine-grained dark brownish rock, making a very good building stone.

Lackawannock.

§ *58.* This township lies east of Hickory and Shenango townships and north of Wilmington.

It is mostly an elevated area with the draining streams along its borders.

The *Little Neshannock* makes its eastern boundary, while the west branch of the same stream drains its western parts.

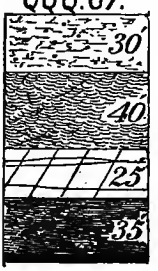
The section of its rocks extends from the *Sharon coal* up to a few feet above the horizon of the *Ferriferous Limestone;* but as the upper part of the section is rarely exposed this limestone has never been seen within the township; although the surface at some points must rise as much as forty or fifty feet above its horizon. The *Drift* deposit however is quite heavy over this region, and the limestone may have been entirely removed from beneath it.

The *Sharon coal* comes into the township with a workable thickness, but has never been mined except at one locality, near the west line. Nevertheless, Mr. Walter Pierce's drillings have made out a considerable area of it near Greenfield, on the Madge farm, and also further south on the Buchanan farm. The bed varies in thickness from 3′ to 4′, so that the time may come for a considerable development.

The mine alluded to is near the west line, on the land of Mr. Wise, at Kimberly, Filer and Company's Shaft, which gives the following section: Figs. 67.

67. The Wise Section; Lackawannock T.

1. *Drift,*	30′
2. Shale,	40′
3. Sandstone, white, very hard,	25′
4. Black state,	35′
5. *Sharon Coal,*	3′
	133′



The coal is here quite irregular, frequently thinning en-

tirely away, and again thickening up to 3′ 10″. Toward the east it thins to a feather edge and disappears. It is a very fine *block coal*, and is shipped via the Sharpsville R. R. to Sharon and Erie at the rate of 250 tons daily when the works are in full operation.

In the roof shales (No. 4) are immense quantities of fossil plants. I saw immense quantities of *Whitleseya elegans*, New'by; and this is the only locality in Pennsylvania where I have ever seen it. Also great quantities of *Alethopteris lonchitica*, *A. grandifolia*, *Pecopteris inflata*, as well as several species of *Lepidodendron*, *Sigillaria*, *Cordaites*, *Cardiocarpus* and *Trigonocarpus*,—finely preserved.

About 20 rods east from the mouth of the shaft the *Mercer Lower Limestone* has been extensively quarried and burned on the land of Mr. Wise; 20 inches thick; in two layers, the upper one the thickest and purest; of a dark bluish color; quite fossiliferous; and burning into a very strong fair lime.

The interval between this limestone and the mouth of the Kimberly and Filer shaft was very carefully leveled for the purpose of getting the vertical distance from it down to the *Sharon coal*, which was found 30 feet higher than the shaft. Making no allowance for dip this would give 160′ between limestone and coal. The slight east dip would probably increase it by a few feet.

About 20 feet above the limestone a 2′ coal, immediately under a massive sandstone, has been opened in one or two instances; but it comes too near the surface to be of any importance. It probably represents the *Mercer Upper Coal* and the rock above it, the *Homewood Sandstone.*

Nothing was seen of the *Mercer Lower Coal*, and it is probably absent here.

It has been mined, however, in the south-western corner of the township, on the property of Mrs. Love, by the Carbon Coal Company, represented by Mr. Phillips. The bed, reached by a drift, varied from 2′ 6″ to 4′ in thickness, and when the mine was first opened, was supposed to be the

Sharon; for the coal has a *semi-block* appearance, but contains much more ash than the Sharon coal, and it could, with difficulty, be marketed. It was shipped at one time to Erie, but the mines are now idle.

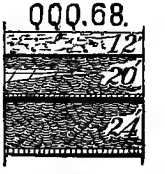
The elevation above tide, according to the levels of Mr. Walter Pierce, of Sharpsville, is 1118′.

The *Mercer Lower Limestone*, 3′ thick, occurs in the roof of the mine.

An air shaft, 65′ deep, was sunk on the hill above the mine's mouth, and passed through the following series of strata: Fig. 68.

Fig. 68. Carbon Co.'s Section; Lackawannock T.

1. Surface,	12′
2. Coal,	1′ 6″
3. Shales and sandstone,	20′
4. *Mercer Upper Limestone*,	2′
5. *Mercer Upper Coal*,	2′ 6″
6. Shales,	24′
7. *Mercer Lower Limestone*,	3′
8. *Mercer Lower Coal*,	—
	65′



(No. 2) may represent the *Brookville coal;* or it may be one which in Lawrence county frequently appeared 20′ or so above the *Mercer Upper Limestone.**

Both the Upper and Lower *Mercer Limestones* are very fossiliferous at this locality, and both are of a dark bluish color, though the lower one is rather the darker.

As we pass east from here, the hills rise 160′ above the level of the *Mercer Lower Limestone*, and should catch the

* It is a curious fact that the belief seems to have taken hold of many people, otherwise quite intelligent, that when any of these upper coals are present, the Sharon below need not be looked for; since they think there is some connection existing between the two, such that when one is present, the other is always absent. I suppose the foundation for this opinion to be, that in the area where the Sharon coal exists the hills are seldom or never high enough to take in any of these upper beds. Certain it is that the presence or absence of the one could in no manner affect the existence of the other. And Mr. Pierce's drillings have made it plain to everybody that both exist in the same vertical section at many localities in this township.

Ferriferous Limestone, but I saw nothing of it. This elevated area trends north and south as far as Greenfield.

Buchanan farm borings.—About two miles south of Greenfield village, Mr. Walter Pierce, of Sharpsville, has found a considerable area of workable *Sharon coal*, on the Hays and Buchanan farms, as has been already said. Each drill hole was accurately leveled by him, the datum used being New Castle and Franklin railway grade at Wilmington Station, =928′ above tide. No record was kept of any rock but coal.

Fig. 69. Hays & Buchanan farm boreholes; Lackawannock T.

Drillhole	*No. 6.*	*No. 7.*	*No. 15.*	*No. 16.*	*No. 18.*	*No. 19.*
Interval, ...	64′	100′	299′	268′	83′	282′
Coal, ...	2½′	2′	—	—	4′	—
Interval, . . .	213′	185′	—	—	185′	—
Sharon Coal, . .	3½′	3½′	4′	3′	4′	3½′
	283′	290½′	303′	271′	276′	285½′
Drill hole above tide, . . .	1247′	1255′	1264′	1227′	1234′	1255′
Sharon coal above tide, . .	968′	968′	965′	959′	962′	973′

These holes were drilled along a nearly northeast and southwest line, and seem to show the Sharon bed of workable thickness.

Mr. Pierce has leased the lands and expects to sink a shaft for the Sharon coal when the mining business improves.

The coal found above the Sharon bed in nearly all the shafts doubtless represents the *Mercer Lower*, which appears at the distance of a mile to the south, at the Carbon coal works.

The one reported as struck in borehole No. 6, (Fig. 69,) may perhaps be the Mercer *Upper*.

Madge Farm borings.—About one and a half miles northwest from the Buchanan farm we come to the Madge farm,

on which Mr. Pierce has also drilled several wells in search of the *Sharon Coal.*

The following record of No. 1 borehole is from the log-book of Mr. S. O. Bailey, the driller:

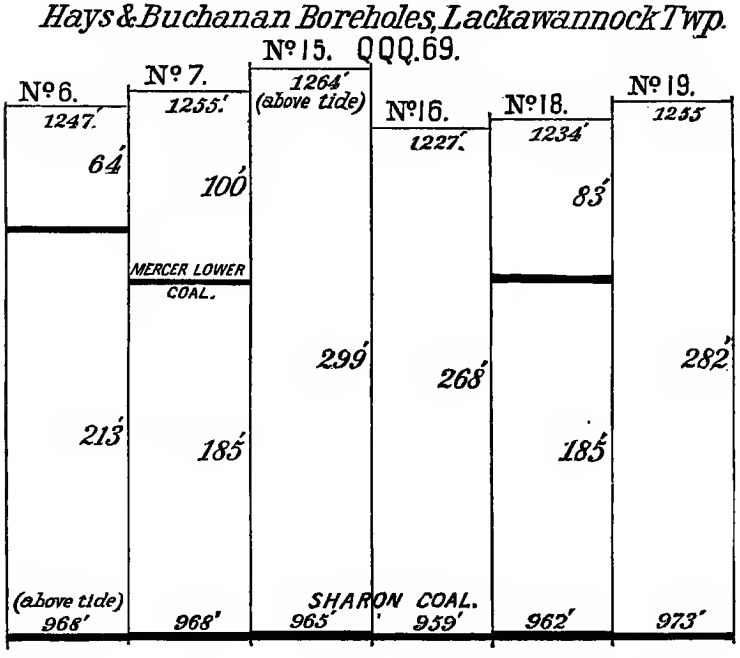


Fig. 70. Madge Farm boring record, No. 1; Lackawannock T.

0. Surface, 1207′ above tide,	0′	
1. *Drift*,	40′	
2. Black slate,	48′	6″
3. *Connoquenessing Sandstone*, massive,	78′	6″
4. Shale,	7′	
5. Slate, dark gray,	17′	6″
6. Slate, gray,	4′	3″
7. Slate, dark gray,	4′	
8. Black slate,	1′	
9. *Sharon Coal*, (1007′ above tide,)	3′	2″
	203	11″

(No. 3) represents the Connoquenessing Sandstone, which

is here very massive, and may possibly represent both the upper and lower members of that rock.

Madge No. 2.—Surface level, 1197′; *Sharon Coal* level, 1000′.

Madge No. 3.—Surface level, 1201′; *Sharon Coal* level, 3′ 6″, 1004′.

Fig. 71. Madge Farm boring record, No. 4; Lack. T.

0.	Surface level 1224′ above tide,	0′
1.	*Drift*,	19′
2.	*Homewood Sandstone*,	61′
3.	Slate and shales,	20′ 6″
4.	*Connoquenessing Sandstone*,	89′
5.	Slate, dark gray,	4′
6.	Fireclay,	3′
7.	Slate, light gray,	3′
8.	Black slate,	10′ 6″
9.	Slate, light gray,	4′ 6″
10.	Slate, hard gray,	21′ 6″
11.	*Sharon Coal* (988′ above tide),	3′ 6″
		239′ 6″

The great development of sandstone in this boring is remarkable, and especially so since all these borings are on the same farm, not more than half a mile apart.

(No. 2) is at the usual horizon of the *Homewood Sandstone*, and was reported by the driller quite hard and in some portions pebbly.

(No. 4) seems to represent both the *Connoquenessing Upper* and *Lower Sandstones*, here united into one; reported by the driller to be a hard grayish-white rock all the way through it.

Not far away from this last hole was bored the Madge, No. 5, Fig. 72.

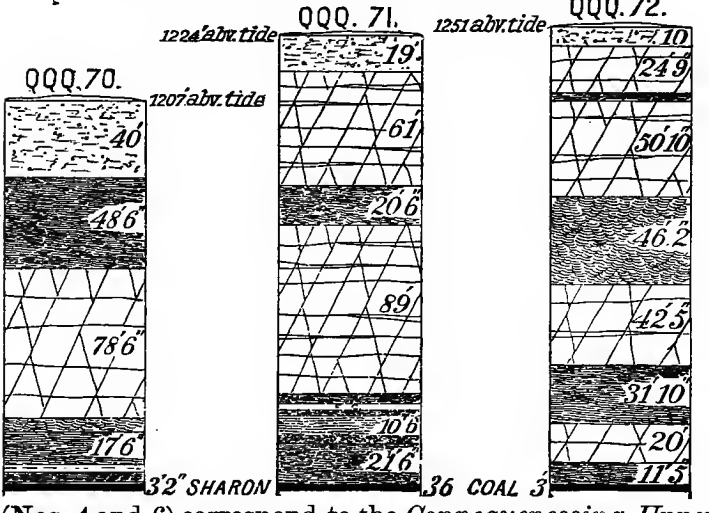
Fig. 72. Madge Farm boring record, No. 5; Lack. T.

0.	Surface level 1251′ above tide,	0′
1.	*Drift*,	10′
2.	*Sandstone* (top of *Homewood?*),	24′ 9″
3.	Slate gray,	4′
4.	*Connoquenessing Upper* Sandstone,	50′ 10″
5.	Shale gray,	46′ 2″

6. *Connoquenessing Lower* Sandstone,	42′	5″
7. Slate, dark gray,	31′	10″
8. Sandstone, very hard,	20′	
9. Slate, light gray,	11′	5″
10. *Sharon Coal* (1005′ above tide),	3′	
	244′	5″

Here again we see a great thickness of sandstone (No. 2;) most probably the top of the *Homewood;* 230′ being the interval between the top of that rock and the *Sharon Coal;* corresponding closely with direct measurement of this interval, which I once made at the Cleveland shaft, in Trumbull county, Ohio, 2½ miles west from Sharon, where I found it 235′.

Borings at Madge Farm Lackawannock Twp.



(Nos. 4 and 6) correspond to the *Connoquenessing Upper* and *Lower Sandstones*, reported to be quite hard and massive.

Mr. Pierce informs me that when (No. 7) was reached the drillers pronounced it "*bottom*" and wanted to give up the boring as useless, but he kept them at work until the coal was struck.*

* This is only one of many instances where in drilling for the *Sharon coal* the so-called "*bottom*" of the drillers has proved a fallacious guide, the kind of material they term "*bottom*" being found quite as frequently *above* as *below* the coal.

When (No. 8) was entered the drillers were ready to swear to it as the sandstone which lies beneath the Sharon coal. It is a very silicious rock, and the rate of drilling was but one foot per day.

On the Burgess lot, just north from the Madge farm, a hole was also put down, with the following results:

Elevation of surface,	1258′ above tide.
Depth to coal,	263′
Sharon coal (3′ 10″),	995′ above tide.

On the Dunlap farm north from this, and near Greenfield, several borings were also made, the record of one of which reads as follows:

Elevation of surface,	1247′ above tide.
Depth of hole,	230′
Sharon coal (1′ 8″),	1017′ above tide.

The bed was nowhere on the Dunlap farm found more than two feet thick.

A short distance north-east from Greenfield several holes were once drilled for the *Sharon coal* on the Hunter farm; one drilled near Mr. Hunter's house struck the *Mercer Lower Coal* (*?*) at 113′, and the *Sharon Coal* (20″ thick) at 246′.

Another hole commencing about 20 feet lower elevation than the last, struck the *Sharon coal* at 232′.

In no one of four holes bored on this farm was the bed more than 20″ thick.

North and east from this locality there seems to be a considerable area of what is termed the "Upper Coal;" by which is meant a bed lying considerably above the Sharon, and very probably the first struck in the boring near Mr. Hunter's, probably the *Mercer Lower Coal.*

On the land of Mr. Blackston a shaft was once sunk for this coal by Mr. Filer; about 80′ deep; coal 3′ thick, but too slaty to mine. The place has been so long abandoned that I could learn nothing definite about it.

Elevation of mouth of shaft, 1309′ above tide.

At the eastern boundary of the township along the Mercer and Middlesex road, the *Sharon coal* was once opened,

on the land of Mr. Gordon, a short distance west of and 20′ above the Little Neshannock creek; only 18 inches thick, and not followed far into the hill.

The bed here lies 230′ (by barometer) below the mouth of the drill hole at Mr. Hunter's, north from Greenfield. This would make the Sharon coal here 1054′; that is, 16′ higher than at Hunter's, 1038′. It also lies here 160′ below the level of the *Mercer Lower Limestone*, as observed 2½ miles east.

East Lackawannock.

§ 59. This township lies directly east of Lackawannock, and north of Wilmington; and its northern portion extends east to the borough of Mercer.

It is drained by three streams;—the Little Neshannock forms its western boundary and carries off the water from that region;—Lackawannock creek rises in its northern portion and passes north into the Shenango at its "Big Bend;" and the Neshannock flows south a short distance from its eastern boundary, and receives the drainage from that direction.

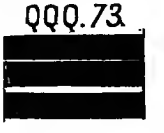
The section of its rocks extends from about 40′ above the top of the *Homewood Sandstone* down to 20′ below the horizon of the *Sharon coal.*

One mile west from Mercer, in the north-western portion of this township, an elevated region contains a small area of the *Brookville coal*, so extensively mined at Pardoe.

The structure of the bed, which has been mined here for fifty years on the land of Mr. Jos. H. Wright, may be seen in the following section, Fig. 73.

Fig. 73. J. H. Wright's Coal Bank; Lackawannock T.

Brookville Coal,	Coal,	1′ 3″	3′ 11.5″
	Parting,	1″	
	Coal,	1′ 3″	
	Parting,	0.5″	
	Coal,	1′ 4″	



The lower bench has been occasionally used for smithing, but the upper is too sulphurous for that purpose. Mercer was supplied with fuel from this mine for a long time, until the railroad brought in coal from other mines to compete with it.

The bed sometimes thickens up to 4′ 6″ in the *swamps*, and again thins away to 3′, and often disappearing altogether on the *hills*. It is mined by a slope, 20′ deep, and there is nowhere more than 40′ of surface above it. The extreme upper portion of the bed is so slaty as to be worthless.

Just west from Mr. Wright's bank, it is mined on the land of Mr. Berringer by an entry, from which, following down one branch of "Devil's Hollow," I obtained the following section:

Fig. 74. Devil's Hollow Section, No. 1 Lackawannock T.

1.	Concealed,	20′
2.	Shales, blue,	5′
3.	*Brookville coal*,	4′
4.	Fireclay and shales,	15′
5.	*Coal*—good,	1′ 6″
6.	Concealed,	25′
7.	Shales, sandy,	10′
8.	*Mercer Upper Limestone*, (?)	3′
9.	*Mercer Upper Coal*, (bony and slaty,)	3′
		86′ 6″

Wright's bed (No. 3) is here a very fair rich looking coal; black and shining when first mined, but soon becoming frosted over with copperas, showing that it contains pyrites.

Mr. Berringer states that in sinking a drain through (No. 4,) he found Coal (No. 5); quite a good coal; but a new element in the series, and I am inclined to look with suspicion on its alleged presence.

The *Mercer Upper* Limestone, (No. 8,) is a dark bluish rock, quite fossiliferous, once extensively quarried and burned for agricultural purposes, making, it is said, an excellent land lime.

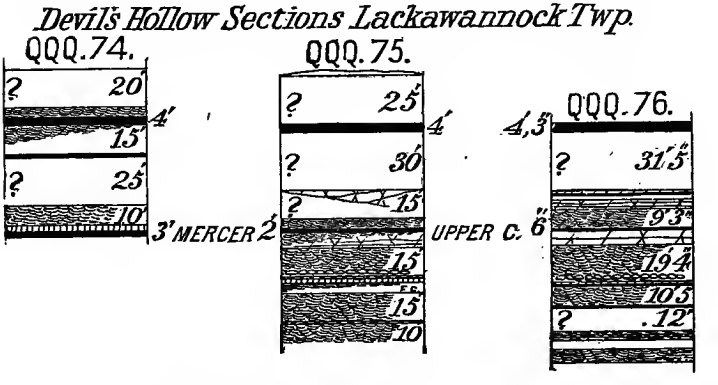
The *Mercer Upper Coal*, (No. 9,) is so slaty and bony as to be of no value whatever.

The *Homewood Sandstone*, which should make its appearance immediately below the *Brookville Coal*, seems to be here entirely wanting.

A short distance west from this, the *Brookville Coal* was once mined by a drift, which puts out on the Mercer and Sharon road, on the land of Mr. Wright, and descending Devil's Hollow from this point, we get the following:

Fig. 75. Devil's Hollow Section, No. 2; Lackawannock T.

1.	Concealed, from hill top,	25′
2.	*Brookville Coal*,	4′
3.	Concealed,	30′
4.	*Homewood* Sandstone, and concealed,	15′
5.	Shales, darkish,	5′
6.	*Mercer—Upper Coal*,	2′
7.	Shales and sandstone,,	8′
8.	Shales, darkish, sandy, ball ore,	15′
9.	*Mercer Lower Iron Ore*,	1′
10.	*Mercer Lower Limestone*,	2′ 6″
11.	Fireclay and coaly shales,	5′
12.	Shales, blackish; ball ore,	15′
13.	Iron ore in a solid layer,	6″
14.	Shales, blackish; visible,	10′
		138′



(No. 4) is probably the lower portion of the *Homewood Sandstone*.

(No. 6,) the *Mercer Upper Coal*, has been stripped con-

siderably along the road which passes down Devil's Hollow. The upper portion is quite slaty, but the lower looks tolerably clean and bright.

(No. 9) is a bed of iron ore in the shape of numerous rounded or kidney-shaped nodules.

(No. 10,) the *Mercer Lower Limestone*, is well exposed at the roadside, and here originally received its name of "Mercer Limestone," during the First Geological Survey of the State. Quarried and burned to a considerable extent, it is very dark, more black than blue, quite hard and compact, and very fossiliferous.

(No. 13,) a little stratum of rich iron ore, was once mined, as well as the kidney ore, in the shales above for the old Cozad furnace, at the foot of the hill, occupies a horizon frequently ore-bearing in Lawrence county, as described in Report of Progress, QQ.

The following Section, Fig. 76, was placed at my disposal by F. H. Oliphant, Jr., of Pardoe, who carefully leveled it:

Fig. 76. Devil's Hollow Section, No. 3; Lackawannock T.

Leveled by Mr. Oliphant.

1. *Brookville Coal,*	Coal,	8″	
	Slate,	1′ 8″	4′ 3″
	Coal,	1′ 11″	
2. Concealed,			31′ 5″
3. Sandstone, dark,			1′
4. *Coal,*			blossom.
5. Concealed,			2′ 4″
6. Sandstone, shaly,			5′ 7″
7. Shale, bluish,			9′ 3″
8. *Mercer Upper Coal,*			6″
9. Sandstone, fine-grained,			7′ 7″
10. Shale, blüish; ore balls,			19′ 4″
11. *Mercer Lower Limestone,*			1′ 11″
12. *Mercer Lower Coal,*			thin.
13. Shale, blue,			10′ 5′
14. *Coal,*			a streak.
15. Concealed,			12′
16. Shale, dark,			2′ 5″
17. Iron ore,			4″
18. Shale, dark,			1′ 8″
19. Concealed,			4′ 9″
20. Shale, black,			7′ 9″
			122′ 6″

This section makes the interval between the *Brookville Coal* and the *Mercer Lower Limestone* 77′. In my hand-leveled Section, Fig. 75, I made it 76′. The limestone, then, in the Berringer Section, Fig. 74, cannot be this one, as the distance is but a quarter of a mile; but must be the *Mercer Upper Limestone*, which consequently has entirely disappeared from the sections along the Sharon and Mercer road.

At the foot of this hill, and on a tributary of Lackawannock creek, once stood the old Oregon or Cozad charcoal furnace, out of blast for twenty years or more. It obtained its stock principally from a one or two foot bed of ore resting on the *Mercer Upper Limestone*, on the Cozad farm. Mr. Cozad, who worked in the mines, informed me that *both the limestones* occur there; separated by 30′ of shales; both underlaid by thin coals; and immediately on top of the upper one the bed of ore, quite variable in thickness, changing at the expense of the limestone; frequently thickening up and entirely replacing the limestone. He states that he has seen *the two limestones exposed* one immediately above the other, each about 2′ thick; and both have been burned to excellent lime.

A short distance south from the old Oregon furnace the Mercer Upper limestone *ore* was once quite extensively mined for Iron City and Oregon furnaces.

The following section, Fig. 77, was made on Mr. Stranahan's property:

Fig. 77. Stranahan Section; Lackawannock T.

1.	Sandstone, shaly,	5′
2.	*Mercer Upper Iron ore,*	1′
3.	*Mercer Upper Limestone,*	2′
4.	*Mercer Upper Coal,*	1′ 6″
5.	Concealed iron bore at base,	25′
6.	*Mercer Lower Limestone,*	2′
7.	Concealed,	10′
8.	Sandstone, massive,	60′
9.	Concealed to level of Lackawannock creek,	65′
		171′ 6″

Numerous strippings of ore (No. 2) were made in this vicinity, in immediate contact with and upon the *upper* limestone; and quite rich.

Some ore was also found immediately above the *lower* limestone (No. 6) but it was not thick.

Both limestones were quarried and burned here, and both are very fossiliferous, and of a dark bluish color.

The *Connoquenessing Upper Sandstone* (No. 8) is here a very coarse, massive, grayish-white rock, making a cascade of the little stream.

A short distance south from here, on the land of Mr. S. Hoagland, where the *Mercer Lower Coal* was once mined, and we get section, Fig. 78.

Fig. 78. S. Hoagland Section; Lackawannock T.

1. Shales,	15′
2. *Mercer Lower Limestone,*	2′
3. Shale,	2′
4. *Mercer Lower Coal,*	2′ 6″
	21′ 6″

The coal was once here mined quite extensively for the neighborhood, but is now abandoned; the upper bench, a hard bony semi-cannel; the lower, softer and more bituminous.

The limestone has been quarried to some extent; dark grayish blue in color, and quite fossiliferous, *Athyris subtilita*, *Spirifer cameratus*, and many crinoidal fragments appearing in it.

One and a half miles south-west from the last, and just east of the Little Neshannock creek, stood the Iron City charcoal furnace, using native ores, and out of blast 1858.

On a small run putting into the Little Neshannock near the furnace I got section, Fig. 79.

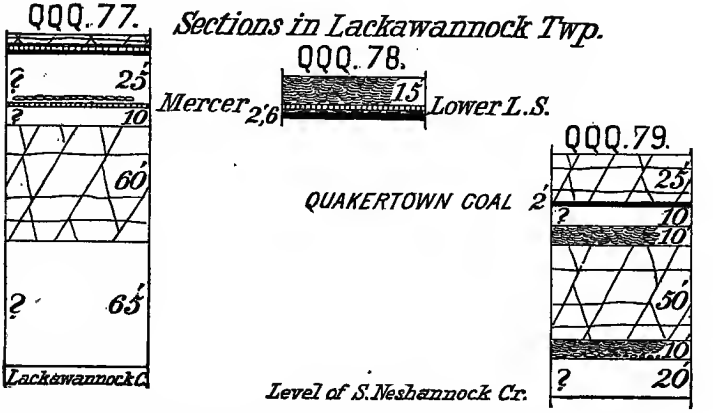
Fig. 79. Iron City Furnace Section; Lackawannock T.

1. *Connoquenessing Upper Sandstone,* massive,	25
2. *Quakertown Coal,*	2′
3. Concealed,	10′
4. Shales, sandy,	10′
5. *Connoquenessing Lower Sandstone,* massive,	50′
6. Shales, dark bluish; ball ore,	10′
7. Concealed to level of the Little Neshannock,	20′
	127′

The *Connoquenessing Upper Sandstone* is here quite massive; and with many quartz pebbles, varying in size from a pea to a hazel-nut. It makes a cascade.

The *Quakertown Coal* (No. 2) was mined by drifting and by stripping while the furnace was in operation, and by report was quite slaty.

The *Connoquenessing Lower Sandstone* (No. 5) so often seen massive above the Sharon coal, is here a grayish-white rock, and quite hard.



(No. 6) containing many nodules of iron ore, was the principal source of supply for Iron City furnace; but there was also a quite persistent stratum of ore from 6″ to 1′ thick. These are the *ore-bearing shales* which often overlie the *Sharon coal*, which, if present here, should be near the level of the L. Neshannock; or at least somewhere in the concealed interval (No. 7.) But it is probable that the coal, if present, would not prove of workable thickness; for, two miles above this, on the west side of the L. Neshannock, it is only 1½′ thick and quite slaty at that.

Findley.

§ 60. This township lies next east of East Lackawannock, and includes the borough of Mercer at its north-western corner.

Just south of its north line *Otter creek* and *Big Mill creek* unite to form the *Neshannock*, which then flows south through the eastern part of the township, receiving nearly all its drainage waters, except from a small area on the east line drained eastward by a tributary of *Wolf creek*.

The rock section extends from the *Ferriferous limestone* down nearly to the *Sharon coal*, or probably a few feet below it; the upper part concealed by drift; the lowest part also almost everywhere concealed along the streams by the silt of the terrace deposits.

The well known *Pardoe coal* of this township underlies a considerable area at the north and center; lying immediately on the *Homewood Sandstone*, and therefore identical with the *Brookville coal*; or perhaps the *Clarion;* it is impossible to determine which, for only one is present.

At Mercer the hill on which the town is situated is made up entirely of the *Conglomerate* Series; the *Brookville coal*, which is mined one mile west, at Mr. Wright's, just barely missing the top here within the borough, about 230′ above the Neshannock; the horizon of the *Sharon coal*, therefore, comes somewhere near the level of the creek.

About 100′ below the hill-top the *Mercer Lower Coal* (?) bed was once opened by Mr. Palmer near the road leading up from the New Castle and Franklin depot, on the property of Mr. MacDonald; reported to me as 18″ thick; and being slaty, the mine was abandoned. Limestone and iron ore were reported to lie immediately above it; but none is visible at the outcrop, although the exposures are good.

Just above it is a very massive sandstone; probably the *Homewood;* but if the coal bed be the *Quakertown*, the *Homewood* Sandstone should be nearer the hill top. Most of the strata seen in the hill side, above and below the coal, are massive sandstones.

Mr. F. H. Oliphant, Jr., and Mr. Lewis, of Pardoe, have traced the outcrop of the *Pardoe coal*, the one mined by Mr. Wright, west of Mercer, over a large area in this township, and have made a connected chain of levels with Pardoe station, on the Shenango and Allegheny railroad, and they have kindly placed the result at my disposal.

Their datum was a point on their coal tipple at Pardoe, which they called 100′, which my levels make 42′ above the railway station (1205′; see Report N). Their starting point is therefore 1247′ above tide, and their zero 1147′.

The highest point in Findley township found by these engineers, is on the Snyder property, two miles south from Pardoe, where their surface level was 246′, = 1393′.

The *Pardoe coal* there, as determined by a drill hole, lay 116′ below the surface =1277′.

At Pardoe, the coal which I shall call the *Brookville*, (though it may with as much reason be termed the *Clarion*,) is mined quite extensively by the Mercer Mining and Manufacturing Company, represented by F. H. Oliphant, Jr., and Company. The entry commences a short distance back from the Shenango and Allegheny railroad depot.

The coal varies from 4′ to 5′ (usually about 4′ 6″); is quite irregular; often cut up by "horsebacks" and clay seams; very good for steam purposes, but contains too much sulphur for iron making, being often completely frosted over with copperas after exposure to the air.

It is shipped to the lakes at the rate of 400 tons daily (300 lump and 100 slack) when the mine runs to its full capacity.

At the mouth of the drift we see the top of the massive *Homewood Sandstone*, and the coal lies only a few feet above it. The tide elevation of the coal in the Pardoe mine ranges from 1270′ to 1280′.

South-west from Pardoe one and a half miles, this *Brookville coal* was once extensively mined by Messrs. Ride and McBurney, near the head of Ride's run; but the workable area is exhausted. The bed was about 4′ thick, and (as leveled) 1290′ above tide.

Farther north, on the land of Mr. Huston, it is still mined near the road by a slope 130′ long and 38′ below the surface and 1293′ above tide. The coal is quite sulphurous and the bed shows the following structure:

Brookville, (Pardoe,)
1. *Coal*, ... 2′
2. Slate, ... 1′ 2″
3. Coal, ... 2′
} 4′ 2″

A short distance west from this it is mined in Mr. Ebert's shaft, 40′ deep; the greater part through *Drift;* but just above the coal a few feet of blue sandy shale. The coal is hauled to Mercer, and is also the source of supply to the surrounding country.

The same bed has also been mined on the lands of Hossack and Venatado, in this vicinity.

Ride's run, flowing north into Little Mill creek at Morris's mill, in passing over the Conglomerates exposes a fine section for a part of the way. Connecting the exposures with the coal in Huston's slope we get the succession in Fig. 80.

Fig. 80. Morris's Mill Section; Findley T.

1.	*Brookville Coal,*	4′ 2″
2.	Concealed (horizontal distance ½ mile),	31′
3.	*Tionesta Sandstone,* massive,	30′
4.	Concealed,	12′ 6″
5.	*Mercer Lower Limestone,*	2′
6.	Slate, black,	12′
7.	*Mercer Lower Coal,*	—
		91′ 8″

This section was made by myself; but the absolute elevations of the *Brookville coal* (1293′,) of the top of the *Homewood Sandstone* (1280′,) of the *Mercer Lower Limestone,* (1247½′,) and of the *coal* below (1223½′,) were determined by Oliphant and Lewis.

The *Homewood Sandstone* (No. 3) is very finely exposed, where the run makes a vertical plunge of 40′ over its top at Crill's saw mill; and its very massive outcrop extends along each side of the stream as perpendicular cliffs. The rock is quite coarse, and some small pebbles may be seen in it. The upper part of it, not seen, probably occupies most of the interval (No. 2.)

Immediately below the sandstone there is seen, at one locality, a *coaly shale,* but as this interval was nearly all concealed by débris at the foot of the Falls, I could not determine whether or not the *Mercer Upper Coal* was present

The limestone (No. 5) is a very hard, dark, fossiliferous stratum, rock, breaking with a sharp angular fracture.

Immediately below it come dark slaty shales, which extend down to the level of (No. 7,) where Oliphant and Lewis stated that they once saw a thin representative of the *Mercer Lower Coal*, covered with débris when I was there.

At Painter's mills, on Little Mill creek, two miles below Pardoe, the following leveled section was made by Oliphant and Lewis, Fig. 81:

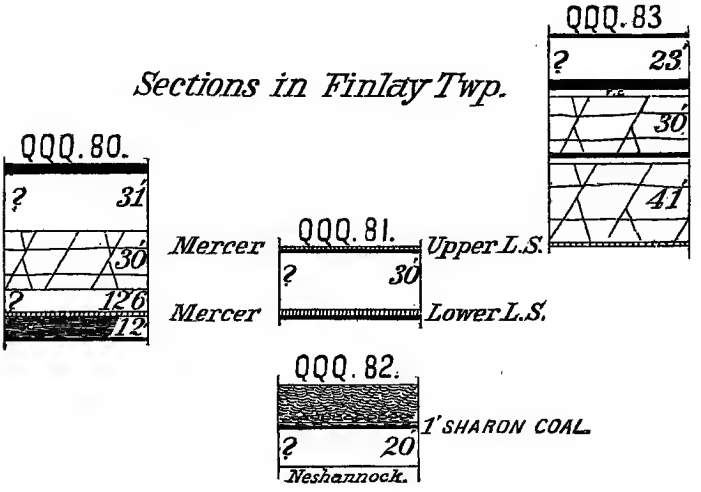


Fig. 81. Painter's Mill Section, Findley T.

1.	*Mercer Upper Limestone,*	2′
2.	*Mercer Upper Coal,*	1′
3.	Concealed,	30′
4.	*Mercer Lower Limestone,*	3′
5.	*Mercer Lower Coal,*	1 6″
		37′ 6″

Here we get both the *Upper* and *Lower* of the *Mercer Limestones*, as well as their *accompanying coals*, in one and the same vertical section; the *Lower* thicker than usual; the *coals* accompanying each slaty and worthless.

North from Pardoe, about ¾ mile, the *Brookville Coal*

was once mined on the land of Mr. Long; and about 300 yards from the mouth of the drift is a *limestone* (probably *Mercer Upper*) 2′ thick, and 39′ below the level of the coal.

Near the northern line of Findley township a high Knob on the land of Mr. McCurdy catches the *Ferriferous limestone;* the summit being according to Oliphant and Lewis, 1400′ above tide.

One and a half miles west from Mr. McCurdy's and just at the northern line of Findley on land of Wm. Barnes the *Ferriferous limestone* is quarried at 1350′.

The *Brookville coal* was once opened a quarter of a mile west from this at 1322′; difference 28′; a quite rapid dip to the west probably increases the interval to 45′ ±.

In the central portions of Findley township where the surface rises over 100′ above the *Brookville coal*, the *Ferriferous limestone* has never been found either cropping out on the surface or in any of the drill holes.

Mr. Oliphant put down air shafts which passed through 50 feet of sandy shales above the coal. *It would seem as if the Ferriferous limestone had never been deposited in Findley township to the south of Little Mill Creek.*

Pine run flows sluggishly and with numerous swamps along the northern border of this township and empties into the Neshannock.

Near Mr. Weber's on Pine run the blossom of the *Brookville* (?) *coal* is seen at 1279′, according to Oliphant and Lewis.

A short distance above Hope Mills on the left bank of the Neshannock we see the following exposure:

Fig. 82. Hope Mills Section; Findley T.

1.	Shales, containing iron ore,	20′
2.	Shales, bituminous,	1′ 6″
3.	*Sharon Coal*,	1′
4.	Concealed to level of the Neshannock,	20′
		42 6″

Here the *Sharon coal* (No. 3) was once stripped on the land of Mr. Mason, with the ordinary character of Block coal, and doubtless representing that bed, as it comes at about the proper horizon for it.

(No. 1) contains numerous nodules of *iron ore* and was once dug to a considerable extent.

Pine.

§ 61. This township lies south-west of Findley (which it adjoins in its western half), north of Liberty, south of Wolf Creek, and along the Venango and Butler county lines.

It is drained entirely by *Wolf Creek*, which flows south through its middle, receiving smaller tributaries from each side, very sluggish streams, often spreading out into extensive marshes, one of which in the south-eastern corner of the township is called "Pine Swamp."

The rock section reaches up beyond the *Ferriferous limestone*, and down below the *Homewood sandstone.*

The only coal of any importance ever mined in this township is the *Brookville*, (or Pardoe) bed, which underlies a considerable area west of Wolf creek, and supplies the Pine Grove neighborhood.

On the land of Mr. Thomas McCoy in the south-eastern portion of the township the *Ferriferous limestone* has been extensively quarried and burned for lime; its top level (Oliphant and Lewis) 1283.8′ above tide; very hard and compact; bluish; quite fossiliferous; 7′ of the lower part only visible; the upper part ground away by ice.

This area of the limestone extends eastward into Butler county.

A short distance north from Mr. McCoy's a high Knob rises 80′ above the horizon of the *Ferriferous limestone*, and near its summit we see the blossom of a coal along the road, probably *the Darlington.*

On the west side of Graham's run and north from McCoy's an elevated ridge of land, on the Dougle, Black, Buchanan and other farms, catches a considerable area of the *Ferriferous limestone*, which is quarried and burned on all of them, but most extensively on the Buchanan farm, where it does not seem to lie in a regular bed, but in large detached masses broken from the original bed and more or less widely separated from each other. The stone when burned makes excellent lime for plastering, as well as for farming purposes.

The general elevation of these limestone blocks is (Oliphant and Lewis) 1293′. But, going east from Buchanan's, the limestone rises quite rapidly and in three quarters of a mile, at Jno. McDougle's, reaches 1333′. At Matthew Black's quarry it lies at 1306′.

Along Wolf Creek the *Homewood sandstone* is frequently exposed in long lines of vertical cliffs, making a wilderness of the upper portion of its course through this township; immense blocks of massive conglomeratic sandstone, overgrown with a tangled growth of laurel, barring all passage.

About one mile above the village of Pine Grove the hills rise high enough to catch the *Brookville coal;* mined there for a long time past, on the Wall's, Dougherty and McGoffin lands.

At Walls' bank the bed is 4′ 8″ thick; with a slate parting, from 1″ to 4″ thick, near the middle; coal rich and shining black, but containing rather too much sulphur for smithing; roof a rather coarse grained sandstone.

Just south from Mr. Walls' Mr. Emery mines it on the McGuffin farm, where the coal is the same; open-burning and excellent for domestic purposes; and 1277′ above tide.

About 35′ below the *Brookville* is the outcrop of a small coal bed about 10′ above creek level: once opened by Mr Emery; 10″ thick; probably the *Mercer Upper Coal.*

Just below the Brookville comes the *Homewood Sandstone*; very massive, making cliffs along the creek; and where quarried on Wall's land, a very hard micaceous rock, without pebbles.

The following leveled section, Fig. 83, was compiled by Messrs. Oliphant and Lewis from widely separated points in the vicinity of Pine Grove; allowance must be made for a quite rapid dip to the south-east in estimating the real intervals:

Fig. 83. Pine Grove Section; Pine T.

1.	*Coal*,	6″
2.	Concealed,	23′
3.	*Brookville Coal*,	4′ 8″
4.	Fireclay,	4′
5.	*Homewood Sandstone*, massive,	30′
6.	*Coal*,	1′ 6″
7.	Concealed,	4′
8.	*Homewood Sandstone*, massive,	41′
9.	*Mercer Upper Limestone?*	2′
		110′ 8″

Nos. 8 and 9 were obtained from the records of a well dug in Slabtown, just above Pine Grove, nearly half a mile below where No. 6 was observed; and it is quite possible that No. 8 is really a portion of No. 5, which has fallen with the dip and been re-duplicated. At all events, when we get to Pine Grove, only a short distance below, the top of the *Homewood Sandstone* is only five feet above water level.

If No. 9 be limestone, (as reported,) it must be either the Upper or the Lower of the *Mercer Limestones*.

Just below where the road crosses Wolf creek at Pine Grove we see the massive *Homewood Sandstone* rising above the water, at 1242′ above tide. (Oliphant and Lewis.)

Near the northern line of Pine township, about one mile east from Wolf creek, on the McGill farm, a coal bed is mined, at an altitude about thirty feet above the level of the coal worked at McGoffin's, and probably the same bed. It is 4′ 8″ thick, with a slate parting 6″ below the top; the bench above the parting being left for the roof. The coal is used for domestic purposes, containing too much sulphur for smithing; area of coal here small.

A short distance south from the coal entry the massive

Homewood Sandstone is exposed at the roadside, just below the level of the coal.

Wolf Creek.

§ 62. This township lies east of Findley, north of Pine, and along the Venango county line.

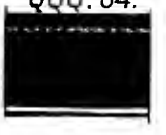
It is drained by the branches of Wolf Creek, except a small area in its south-west corner, drained by Little Mill creek into the Neshannock.

The surface of the township is mostly covered with the *Drift.* Excepting a few small areas of the *Brookville coal*, there is little of geological interest to be seen in it.

In the southern part, and about one mile west from Wolf creek, the *Brookville coal*, mined on the land of Mr. Hume, exhibits at the mine mouth the following structure:

Fig. 84. Hume's Coal Bank; Wolf Creek T.

Slate, bluish,			
Brookville,	*Coal,*	8″	
	Slate,	2″	
	Coal,	4′ 0″	5′ 3″
	Clay,	3″	
	Coal,	2″	



The bed yields here, as usual, a splendid grate coal, but too sulphurous for smithing.

Elevation above tide (Oliphant and Lewis), 1320′.

Further back on the hill it is mined by a shaft, 35′ deep; 26′ through the *Drift;* the rest through a grayish white slate. Aspect of coal, semi-block; has been used for smithing; said to make no clinkers on the fire, and a very small quantity of ash.

In the very north-western corner of this township rises, on the McCraig farm, a small Knob of the *Ferriferous limestone* (Oliphant and Lewis), to 1401′.

At Montgomery's mill the *Homewood Sandstone* outcrops along Wolf creek; and two miles west from this on the farm of T. J. Montgomery, higher land takes in a small area of the *Brookville coal;* 4′ thick; but too near the surface to be good, and it has not been mined for a long time. Its relative altitude (by barometer) is 40′ above the *Homewood Sandstone* at Montgomery's mill.

In the north-eastern part of the township, a coal bed was once opened on Miller's farm, at the horizon of the *Brookville;* reported 4′ thick; but so near the surface that it is slaty and worthless, there being only a few feet of earth above it.

The *Homewood Sandstone*, northward, comes up from under the coal, and immense blocks of it lie about the surface.

The entire northern portion of the township is covered by the *Drift*, and no exposures are visible.

Worth.

§ 63. This township lies north from Wolf Creek township, along the Venango county line; with Sandy Lake township on the north, and Jackson on the west.

The heads of Wolf creek rise in its highlands.

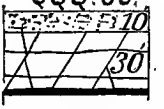
The rock section extends from the *Ferriferous limestone* downwards two hundred feet.

It is covered with a thick coating of the *Northern Drift*, and exposures are anything but satisfactory. The *Drift* consists of clay, or "hard-pan" mixed with bowlders of granite, gneiss, limestone, sandstone, &c. Many large *granite bowlders* are also seen scattered over the surface.

Two miles east from Mill Brook, and near the south-eastern corner of the township, a water well on the Johnson farm passed through the following strata:

Fig. 85. Johnson Section; Worth T.

Soil; *Drift;* "Hard pan,"	10′
Homewood Sandstone, massive, ...	30′
Mercer Upper (?) Coal, ...	2′ 6″
	42′ 6″



No. 3, one of the *Mercer coals*, was once opened by Mr. Johnson, who found it too impure to warrant mining.

About one half mile south from Hendersonville high knobs on the Wheeler farm catch a considerable area of the *Brookville coal;* 4 feet thick; of very fair quality; rich resinous luster; containing a less quantity of pyrites than usual, so that it has been used for smithing.

Mr. Buckley also once mined it in this vicinity.

Another coal bed, 22″ thick, is said by Mr. Wheeler to underlie it 32′. This would naturally be the *Mercer Upper;* unless indeed that coal should be represented by still another reported as seen by Mr. Wheeler on the land of Mr. Moss, as 17″ thick.

Near the northern line of the township a coal bed was once mined by Mr. Armstrong; 140′ below the Brookville; 3′ thick; with a band of slate near its middle; quite slaty and worthless; probably the *Quakertown coal.*

In the vicinity Mr. Burnett once mined the *Brookville coal;* the area is nearly worked out and the mine abandoned.

Under Burnett's coal, 25′, the massive *Homewood sandstone* crops out; and at 85′ a smut probably represents the *Mercer Lower coal.*

Near Hendersonville a very high knob is capped by a small area of the *Ferriferous limestone,* "8′ thick," on the land of Mr. John Henderson; who once quarried and burned it there. Only a few blocks of it can now be seen; of a light ashen gray color; quite fossiliferous.

Hendersonville has an altitude of more than 1500′ above tide. Here most probably is the highest land in the county.

Armstrong's gas well. About one mile east from Hendersonville, near the Venango county line, on the land of Mr. Armstrong, *gas* still continues to roar from a well (which produced no oil) in sufficient force to make a flame, when ignited, more than 20 feet high. The well mouth is 175′ below the level of the *Brookville coal;* but I could not learn at what depth the gas was struck.*

In the south-west part of the township, near the Jackson line, the *Brookville coal* is mined on the land of Mr. Patterson; about 4′ 6″ thick; contains a large amount of pyrites, but is in high repute as a domestic fuel; dips strongly south-west, and underlies 400 or 500 acres.

Near the extreme south-west corner of the township, a high knob, on the land of Mr. McKee, catches and holds a small area of the *Ferriferous limestone*, at (Oliphant & Lewis) 1408′ above tide.

Jackson.

§ 64. This township lies west of Worth and north of Findley.

Big Mill creek flows through it from its north-east corner to its south-west, draining its whole area,—except the western border, which goes into *Cool Spring creek* before entering Big Mill creek,—and a small area on the extreme southern border which has its water carried off by way of *Little Mill creek*, only to unite with the main stream a short distance west from the Jackson line.

This township has some very elevated land, which catches not only a considerable area of the *Brookville coal* but also several patches of the *Ferriferous limestone.*

* The drillers reported that at a depth of 280 feet they passed through a splendid bed of coal 12′ thick, but of course this is one of the "jokes" which the average oil driller delights to perpetrate on a too confiding inquirer, since that horizon would come at least 200 feet below the *Sharon coal*, which is the last in the descending series in Western Pennsylvania.

The rock-section therefore extends from the *Ferriferous limestone* down to the *Quakertown coal.*

About one mile south-east from Jackson Center the *Ferriferous limestone* is quarried and burned on the land of Mr. Thomas Vernon; 7 feet thick; with only 8′ of *Drift* between it and the surface; upper layers perhaps removed by Glacial action.

The lower bluish portion of the limestone (27″) makes the whitest lime; the rest of the bed has a light grey color; all very fossiliferous.

This quarry has been in operation for fifty years, and the lime is highly valued both for plastering and agricultural purposes.

Immediately below the limestone is seen a bed of coal 6″ thick; quite impure and slaty; the *Scrub Grass Coal* of Rogers.

Not far south of Vernon's on Mr. Egbert's land the *Ferriferous limestone* has been quarried; 9 feet thick; (Oliphant & Lewis) 1348′ above tide.

Just north from the limestone quarry Mr. Egbert once had a slope to the *Brookville coal.*

Elevation of coal in slope, 1302′; interval between limestone and coal, 46′; dip, slight, southward; true interval, say 50′.

The coal is not now mined at Egbert's, but is reported to be 4 feet thick, with a band of slate near its middle.

About three fourths of a mile south from Egbert's there occurs another area of the *Ferriferous limestone* on the land of Mr. Barnes, where it was once quarried quite extensively.

One mile east from Jackson center the *Brookville* (Pardoe) *coal* is now extensively mined by the Jackson Coal Company, at (Oliphant & Lewis) 1293′ above tide; bed irregular; frequently cut up by "horsebacks;" normal thickness 4′ to 5′; often suddenly thinning; contains too

much *pyrites* for smithing and iron make; is used entirely as a domestic fuel and for steam purposes; and is shipped at the rate of 150 tons daily, via the New Castle and Franklin, and Lake Shore and Michigan Southern (Franklin Branch) railroads.

About one mile below the Dight Mills on the Big Mill creek a coal was just being opened when I visited the locality, on the land of Mr. Orr; near the level of the creek; 1186′ above tide (Oliphant and Lewis); therefore 116′ below the level of the *Brookville coal* at the slope of the Jackson Coal Co. two miles to the north-east;—coal, 2′ thick, and of course somewhat friable at the entrance; structure and appearance that of "Block" coal; roof black slate; probably the *Quakertown coal* bed.*

About 20′ above the coal is seen the outcrop of a massive sandstone, probably the *Connoquenessing Upper Sandstone.*

One mile below this, on land of Mr. Harrison, the same coal bed was once stripped out of the bed of the creek.

It was also once mined on the land of Mr. Comstock, and is known through this region as the "*Comstock coal.*"

Near the north-western corner of this township the *Brookville coal* has been mined on the land of Dr. Egbert; 4 feet thick, and of very fair quality.

Cool Spring.

§ 65. This township lies west of Jackson, and north of Findley; its south-west corner touching the borough of Mercer.

Otter creek flows south almost through its center, and *Cool Spring creek* flows along its eastern border.

The *Drift* spreads an almost unbroken covering over it, concealing the geology.

*The entry was falling quite rapidly towards the north-east.

Just north from Mercer, along the Cool Spring road, we see the outcrop of a very massive sandstone, probably the *Homewood*, far up in the hill.

One mile north from Mercer, on the land of Mr. Shannon, the *Lower Mercer Coal* (?) (reported 2′) rather impure and slaty, was once opened.

Jefferson.

§ 66. This township lies east of Cool Spring and north of Lackawannock and East Lackawannock.

The *Big Bend of the Shenango* comes into the northern portion of the township, and then curving westward forms its northern boundary.

Lackawannock creek flows north through its middle part and empties into the Shenango at the Big Bend.

The rock-section extends from the *Homewood Sandstone* far down into the *Cuyahoga Shale*, in the Shenango valley.

In the western portion of this township the *Mercer Iron Ores* were formerly extensively mined.

On the land of Mr. McCullough a regular plate of ore, 12″ to 18″ thick at the horizon of the *Mercer Upper limestone*, was mined up to 1865, and shipped to the furnaces in the Shenango valley, as well as to the old Clay furnace at the western line of this township.

Three fourths of a mile south from this, Mr. Zahneizer mined the *Mercer Lower Ore*, lying 40′ below McCollough's.

The *lower* ore was also mined in the same vicinity, on the land of Mr. McDowell; varying in thickness from one to two feet, and apparently replacing the limestone entirely.

A small coal immediately under the *ore* would represent the *Mercer Lower coal.*

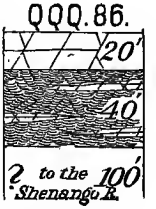
Near the western line of the township was the old Clay charcoal furnace, out of blast many years ago, and now in ruins. It used *Upper* and *Lower Mercer* ores, and *bog* ore

from Keel Ridge in Hickory township, transported via the old Erie and Beaver canal.

About half a mile below the Big Bend of the Shenango we get the following section in descending the left bank of the stream, opposite the old lock on the Erie and Beaver canal:

Fig. 86. Big Bend Section; Jefferson T.

1.	*Shenango Sandstone*, massive, ferriferous,	20′
2.	Shales and flaggy sandstone,	40′
3.	Concealed to level of the Shenango,	100′
		160′



The Shenango Sandstone (No. 1) lies 40′ to 50′ below the base of the *Sharon Conglomerate;* brownish or buffish colored; quite massive, and containing numerous balls of iron ore; was once quarried for building the lock on the old canal, close by.

The bluish sandy and argillaceous shales (No. 2) becoming quite arenaceous near their base are a portion of the *Cuyahoga Shale* formation.

Just above the elbow of the Big Bend, on the west (right) bank of the Shenango, a ridge rises to a height of 400′ above the water, or about 200′ above the proper horizon of the Sharon coal.

Several *beds of ore* were found, and one of them extensively worked (by entries) for the old furnace at Big Bend. This bed of ore lies at the horizon of the Sharon roof shales; but the *Sharon coal bed itself was absent*, and no other coal bed of any importance was found, but although the hillside was stripped from top to bottom in search of coal and iron ore.

The Conglomerate Series extends to the summit, crowned by the *Homewood Sandstone;* huge masses of coarse and conglomeratic sandstone encumber the slopes.

The *Shenango Sandstone*, (No. 1, of the last section,) was once extensively quarried on the right bank, about half

a mile above the Big Bend; 25 feet thick; containing ore balls; tolerably coarse in grain; grayish-white, and beautifully specked with perroxide of iron; splitting freely into blocks of any size; and *abounding in fish remains*, (many *fragments of bones, with scales*, &c.) In one block I found the cast of a beautiful *Ctenacanthus*.

Below the level of this quarry-rock all is concealed, for 150′, down to water level.

Down the stream a short distance, an *oil well* was once drilled to a depth of 1700 feet, commencing about 20 feet above the level of the Shenango. A show of *oil* was reported at 600′, and a vast flow of *gas* at 700′. Gas continues to bubble from the hole, filled up with rubbish. As at Sharon and Beaver Falls, *no sands were passed through below 700′*.

Pymatuning.

§ 67. This township at its southeast corner adjoins Jefferson, and lies north of Hickory, and along the Ohio State line.

It is drained by the Shenango, which enters its northeast corner, and then veers away southeastward until, reaching Big Bend, it turns suddenly northwestward and reënters the township over its south line.

The principal tributary of the Shenango within this township is *Pymatuning creek*, a long and sluggish stream, rising in Ohio, and entering Pennsylvania at Orangeville.

The surface is covered deeply with the *Drift*, especially along the streams, where immense heaps of cobble stones and Drift material are often seen, where the erosion of the surrounding surface has left the more resistant portions of the Drift above the general level.

Near its mouth at least, the Pymatuning has a *buried channel more than 100 feet deep* below the present bottoms. This was discovered in building the Sharon branch of the A. &. G. W. R. R. A short distance north from where

this railroad crosses the Pymatuning, occurs a great marshy tract known as the Tamarack Swamp, and as the route of the road passed through this swamp, the engineers of the road attempted to get a solid bed for the track by making a "fill." Accordingly the dirt carts were set to work, and hundreds of loads were dumped into the swamp; but it was found that all that could be built up in the day would disappear in the swamp by the next morning, so that the attempt to get the track across in this manner was abandoned, and the plan of driving piles substituted. These were spliced and driven to a depth of over 100 feet without then striking any solid rock, as the piles which at first seemed to have struck the rock at this depth have since begun to sink away from the timbers on which the track rests. This would place the old valley bed 80 feet below the present level of the Shenango, if the piles had struck rock at 100 feet.*

It is probable that the Shenango has not always flowed around the great elbow of the Big Bend, but that anterior to the Glacial epoch it cut straight across it, following closely the present depressed line of the Erie and Pittsburgh railroad, a wide gap, cut down about 200 feet below the top surface of the bordering hill country; and near the highest point (or water-shed) in this gap, Mr. Paaley drilled a hole for water through 60 feet of sand, clay, and detrital matter without reaching any solid rock.

The section of rock-exposures in this township extends from 100 feet above to 300′ below the *Sharon coal;* a considerable area of which lay in the township, and is now mostly exhausted.

About half a mile above where the Sharon Branch of the A. & G. W. R. R. crosses the Shenango out of Sharpsville, a deep railway cutting exposes 25′ of a fine-grained dark-colored rock (Berea Grit?). Near the level of the railroad

* If this *old buried valley* be ascribed to water erosion, the Pymatuning must have formerly flowed at a much lower level than now; but I think it more probable that the same has been cut out by a Glacial stream, grinding down and plowing up the rock to a depth much lower than the drainage ever ran.

track (here 15′ above the Shenango) one layer of this rock contains vast numbers of *Discina*, *Lingula*, *Allorisma*, *fish remains* and *fragments of wood;* a large *Orthoceros* (one inch in diameter) and *water-worm pebbles of shale.*

Near the south township line is an old and extensive stone quarry, in the *Sharon Conglomerate*, here 225′ above the rivel level at Clarksville; quite coarse; of a reddish gray color; without pebbles and inclined to be gnarlly and false-bedded; and used for building the canal locks.

In the vicinity of Clarksville we see two very well marked *terraces;* the first at 10′ to 15′ and the second at 100′ to 120′ above the water; both stretched out in broad level areas between the junction of the Shenango and Pymatuning.

About two miles south-east from Transfer station a small and nearly exhausted area of *Sharon coal* occupies the land of Mr. Campbell, just south from the Big Bend road. Large blocks of a very white sandstone above the coal probably represent the *Connoquenessing Lower Sandstone.*

Near the Lutheran church about three fourths of a mile east from the old coal drift and at a level 80′ lower, crops out a very massive sandstone 25′ thick, containing many balls of iron ore; probably the *Shenango sandstone.*

Just west from Transfer station, the hills rise 175′ above the level of the railroad and take in a considerable area of the *Sharon coal*, mined at an elevation of 1130′ above tide, by a slope, on the land of Mr. Livingstone; and here descending the hill side to Transfer we get the following section:

Fig. 87. Livingstone Section; Pymatuning T.

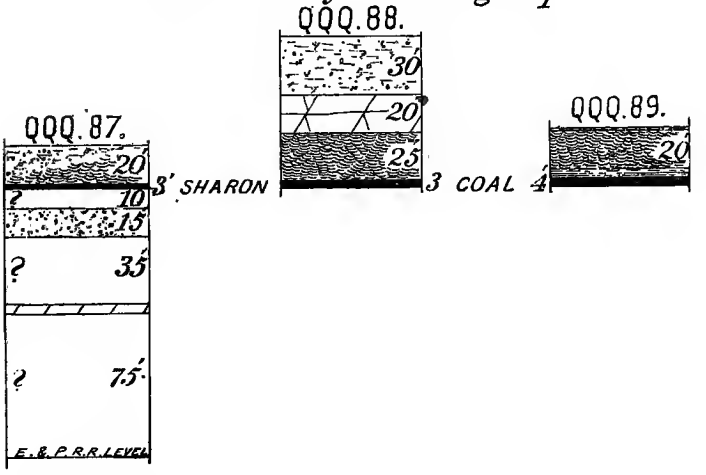
1.	Surface soil and shales,	20′
2.	*Sharon Coal* (1130′ above tide),	3′
3.	Concealed,	10′
4.	*Sharon Conglomerate*,	15′
5.	Concealed,	35′
6.	*Shenango Sandstone*, massive,	5′
7.	Concealed to level of E. & P. R. R. at transfer station,	75′
		163′

The shales (No. 1) immediately above the coal are darkish and contain many fragments of fossil plants.

The *Sharon Conglomerate* (No. 4) crops out along the hill below the coal in a bold cliff; quarried at one place, where the upper part, not being pebbly, makes a very good building stone; the lower part containing many quartz pebbles, varying in size from a pea to a hazel nut.

(No. 6) probably represents a portion of the *Shenango Sandstone*, and is quite massive where exposed along the road leading west from the village.

Sections in Pymatuning Twp.



About one and a half miles west, or rather north-west from Transfer, the old Prospect coal works were once operated by Hague & Alger, but are now long since exhausted.

The surface rises 100 feet above the coal (which is 1139′ above tide) and is covered with large blocks of massive white sandstone, some of which are quite pebbly.

Below the coal, in a ravine, are seen 7 feet of the *Sharon Conglomerate*, a mere mass of pebbles.

Along the northern border of this township a large area of the *Sharon coal* has been extensively mined by the Morris Coal Company, both by shafts and slopes.

Shaft No. 4, now the present base of operation, exhibits the following strata:

Fig. 88. Morris Coal Co. Shaft 4; Pymatuning T.

1. *Drift*,	30′
2. Sandstone, massive,	20′
3. Shales, dark,	25′
4. *Sharon Coal*,	3′
	78′

(No. 3) contains immense quantities of finely preserved fossil plants, among which were seen *Alethopteris lonchitica*, *A. grandifolia*, *Odontopteris neuropteroides*, *Pecopteris inflata*, and numerous species of *Lepidodendron*, *Lepidophloios*, *Cordaites*, *Trigonocarpus*, *Cardiocarpus*, *Rhabdocarpus*, &c., *the fruits being specially abundant.*

The *Sharon coal*, here quite irregular, varies in thickness from 0′ to 3′. The sandstone above it often descends and cuts out the coal. As the superintendent said, he would often mine a bed of coal one day and a bed of sand the next.

Excellent *block coal* is shipped by a branch line leading from the mines to the Crawford switch of the Atlantic and Great Western railroad below Orangeville.

About 2½ miles south-west from this we come to the State line, at Orangeville, on the Pymatuning; and here, along the stream, we see 40 feet of rock exposed in a sloping cliff.

The horizon is *300 feet below that of the Sharon coal*, and therefore under the *Cuyahoga shale*. The upper portion of this exposure consists of reddish-gray shales, interstratified with thin flaggy layers; but down, near creek level, the shales begin to get much finer and darker; and just below the mill-dam fragments of a dark bluish fine-grained shale in the water-bed are perfectly filled with *Discina pleurites* and *Lingula melie*. This can hardly be the *Cleveland shale* of Dr. Newberry.

About one mile east from Five Corners, near the head of a small tributary of the Pymatuning, is a quarry, in flaggy

layers (6″ to 2′ thick), of a rather fine-grained bluish-white stone.* In one of the layers I saw many fragments of *fish* and one large *Ctenacanthus* spine.

Near the south-western corner of the township the *Sharon Conglomerate* was once extensively quarried for building locks on the old canal; a very coarse, massive, reddish white sandstone; lying (by barometer) 230′ above the level of the Shenango.

About two miles north from Transfer station, the *Sharon coal* is mined by a slope on the land of Mr. Zuschlag, where we get the following section:

Fig. 89. Zuschlag Section; Pymatuning T.

1. Iron ore,	1′ to 2′
2. Shales, dark,	20′
3. Shale, grey,	3′
4. Silicious rock,	1′
5. Shales, bituminous,	1′
6. *Sharon coal*,	4′
	31′

The coal was just lately discovered at this locality; for the presence of the iron ore (No. 1) long deterred the "practical miners," on whom the farmers rely for practical information, from searching for the coal, as they had a superstition that there could not possibly be any coal where the ore was present, and *vice versa*. But a skeptical German bored a hole to find out the truth for himself, with the very satisfactory result of finding the coal bed under the ore, and four feet thick. The bed in the mine varies from 5′ to nothing, and is an excellent block coal.

(No. 4) is a very silicious stratum, almost as hard as a quartzite.

The shales above it contain many fossil plants.

The iron ore (No. 1) was once extensively mined near here, and taken to Greenville Furnace. It is a very rich carbonate, yielding about 45 per cent of iron.

* Berea Grit?

About half a mile north from this, the same ore was once mined on the land of Mr. Kirk.

Where the Shenango passes through the north-east corner of this township, there is a broad level area, running far back to the west, bordering the stream, and 100 feet above it, or 991′ above tide.

Delaware.

§ 68. This township lies east of Pymatuning and north of Jefferson.

It is through this township that the Shenango takes such a wide sweep to the east, only to turn at the Big Bend and retrace its course to the same meridian. The banks of the stream are quite precipitous throughout a large portion of its course, and it receives no tributaries of any size within the township.

The northeastern edge of this area is drained by the head waters of *Otter creek.*

The rock section extends from near the top of the Conglomerate Series down to nearly 200′ below the base of the same; but the lower portion of the section is nowhere fully exposed.

That portion of this township which lies to the west of the Shenango has some very elevated land; for, just west of the Big Bend, the hills rise 450 feet above the water, reaching almost up into the Lower Productive Coal Measures. This high ridge stretches off a long distance westward; but gradually begins to fall away and slope down as we approach the old eroded valley in which Transfer station is situated.

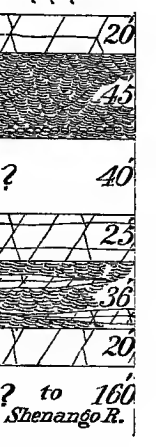
The Mercer and Sharon groups should be found in this ridge; but no coal bed has been reported of available thickness.

About two miles above the Big Bend bridge, descending

a ravine to the Shenango, on the land of Mr. Daniel Moyer, we get Section, Fig. 90:

Fig. 90. D. Mayer Section; Delaware T.

1. Sandstone, massive, ...	20′	
2. Shales, bluish; ball ore, . .	45′	
3. Concealed, .	40′	
4. *Sharon Conglomerate*, sandstone, massive, white, . . .	25′	
5. Shales, sandy; flaggy sandstone, . . .	36′	
6. *Shenango Sandstone*, massive, ferriferous,	20′	
7. Concealed to level of the Shenango, . . .	160′	
	346′	



(No. 1) is a portion of the *Connoquenessing Lower Sandstone;* here very massive and of a buffish-white color.

(No. 2) is the *ore horizon* overlying the *Sharon Coal*, and it was once extensively benched and drifted upon here for the old furnace below New Hamburg. The ore occurs in nodules scattered throughout the shales (No. 2,) and also a portion of (No. 3), and they have been stripped and drifted upon at almost every level to obtain the ore.

The *Sharon Coal* should come in the concealed interval (No. 3,) but nothing is seen of it, and it is probably not present.

The *Sharon Conglomerate* (No. 4) has here no pebbles whatever; is merely a coarse-grained grayish-white sandstone; and was once extensively quarried at this locality for building the locks on the Erie and Beaver canal. Its stones resist the weather in a surprising manner. Where the little stream along which the section was made passes over it, a perpendicular fall of 25 feet exposes the rocks below in a very fine manner. The lower part of the rock often becomes flaggy; and on the land of Mr. Moyer affords

some excellent flagging. This seems to be the same horizon at which the famous flagstones are obtained, at Greenville, in this county.

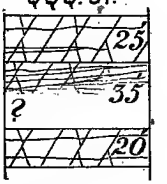
The *Shenango Sandstone* (No. 6) here presents a bold escarpment, and has also been quarried. In it were seen the characteristic iron ore balls which seem to be found with it everywhere.

No exposures were noticed in the 160 feet of rock below this stratum down to the river.

Near the northwestern corner of this township the *Shenango Sandstone* is quarried on the land of Mr. Weikal, and there we get the following Section:

Fig. 91. Weikal Section; Delaware T.

1. *Sharon Conglomerate* Sandstone, massive, . .	25′
2. Sandstone, flaggy and concealed, . . .	35′
3. *Shenango Sandstone*, massive, ferriferous, . .	20′
	80′



The *Sharon Conglomerate*, (No. 1,) here merely a very massive grayish-white sandstone, without a pebble, was once extensively quarried.

The *Shenango Sandstone* (No. 3) is a coarse, soft and tolerably white rock, filled with balls of iron ore, and *fish remains*, (*teeth*, *bones*, *spines*, *scales*,) which lie in a layer near the middle. The sandstone is beautifully specked with oxide of iron.

Many of the balls of iron ore look very much as though they had been rounded in water; and some are flattened. They are soft and *ochreous*.

Over all the eastern portion of the township the coating of *Glacial Drift* is so thick that the streams have accomplished but little in removing it; so that the underlying rocks are always concealed, and nothing can be told about them, except that all the surface rock certainly belongs to the Conglomerate Series.

Fairview.

§ 69. This township lies east of Delaware and north of Cool Spring.

Otter creek flows along its western border, and drains its western half; *Cool Spring creek*, along its eastern border, and drains its eastern half. The greater part of it is an elevated table-land, covered deeply with *Drift.* And near the northern line is an extensive morass, having somewhat the shape of a crescent, called *Half Moon Swamp.*

The rock section extends from the top of the *Homewood Sandstone*, to below the base of the Conglomerate Series.

Near Fairview village a drill hole was bored by Mr. Harkness, which at a depth of 40′ passed through 3′ of *Mercer Lower Limestone*, lying immediately on 3′ to 4′ of *coal;* and both of them underlie a considerable area in the northern portion of the township.

Just west from Fairview village, Mr. J. McCague has an extensive quarry in the *Sharon Conglomerate*, here forming a line of cliffs around the hill; a coarse, massive, reddish-white sandstone, dressing nicely into a handsome building stone; the top of the stratum of a rusty red color from iron stains.

About one mile south-east from Fairview village, a coal has been mined on the land of Mr. Coleson; 2′ 6″ to 3′ thick; immediately underneath a massive sandstone. It comes at the same level as the *Mercer Lower Coal* in the Fairview bore-hole, and is perhaps the same bed; in which case the *Homewood Sandstone* has thickened so as to rest upon the coal. Mr. Coleson states that when the sandstone does not rest immediately upon the coal, *a bed of iron ore* often comes in above the coal, in the place usually occupied by the *Mercer Lower limestone*, which we often find converted into or at all events replaced by iron ore.

Lake.

§ 70. This township lies east of Fairview, and north of Jackson.

This elevated region is the common heading ground of many streams: The *Little Shenango* rises here, and flows to the north-west; *Big Mill creek* and *Cool Spring creek* rise at its southern and western borders; and the waters from *Sandy Lake* flow from it east into *Sandy creek.*

The column of rocks exposed in this township extends up into the base of the Lower Productive Coal Measures; and there is a larger area of the *Brookville Coal* than in any other township in the county.

The surface at some localities is 80′ or 100′ higher than the *Brookville coal.*

No traces of the *Ferriferous Limestone* have ever been seen, and it is very likely that this characteristically localized rock was never deposited here.

In Glacial times a broad stream of ice flowed across the north-east corner of the township, along the present valley of the *Little Shenango*, and through the basin occupied by *Sandy Lake;* an oval sheet of water, partly in Lake and partly in Sandy Lake townships; a mile wide and a third of a mile long; and bordered by steep bluffs, which rise 200′ above its level.

From the western extremity or head of the lake, a broad Drift-filled valley leads off to the north-west, at only a slight elevation above the present level of the lake. Along it runs the Jamestown and Franklin railroad, from the lake, over the divide, to the head, and down along the course of the Little Shenango; but the rise of the divide is quite insensible, and the actual location of the highest place in the bed of the valley undetermined. But the water shed is probably not more than fifty feet higher than the level of the lake. As numerous *Glacial striæ* are seen all along the valley, and running in the same direction,

there can be no doubt that a glacier has done some of the excavation, and very probably flowed eastward along Sandy creek as far as the Allegheny river.

Near the western margin of this township the *Mercer Lower coal* is mined on the land of Rose and Barker, under the local name of "*Slater coal*," from another mine on Mr. Slater's land. It varies in thickness considerably, running usually from three to four feet; the upper part, for one foot, an impure cannel, filled with *plant remains* so macerated as to be undeterminable; the rest rather friable and dirty, but used to a considerable extent for domestic fuel in the surrounding country.

The *Mercer Lower limestone*, 2′ 6″ thick, of a dark bluish color and a perfect mass of fossils, immediately overlies the coal and has been here quarried and burned to a considerable extent.

About one mile south from this, on Mr. Perry's land, the same *Mercer Lower coal*, 3′ thick, but so slaty that it was not of much value, was once mined by a shaft 40′ deep.

Near the south-western corner of the township the same *Mercer Lower Coal* was once mined by an entry (now abandoned) on the land of Mr. Williamson, but I could learn nothing of its thickness.

In the neighborhood of Stoneboro', on the southern shore of Sandy lake, the *Brookville coal* has long been extensively mined by the Mercer Iron and Coal Company, shipping about 100,000 tons annually, on the Jamestown and Franklin railroad, to the lakes and other points northward.

To Mr. McFall, Secretary of the company, I am indebted for the records of several borings made under their superintendency, as well as for much other information concerning the working of the mines.

At Stoneboro' the coal lies 198′ above the level of Sandy lake or 1379′ above tide.

About one mile south from Stoneboro' the Mercer Iron

and Coal Company drilled a hole down below the level of their coal of which the following is the record:

Fig. 92. Mercer I. & C. Co. borehole, No. 1; Lake T.

1. *Drift*,		23′
2. Rock, grayish white,		30′
3. *Brookville Coal* and slate,		5′
4. Sandstone, white,	*Homewood*,	14′ 6″
5. Sandstone, gray slate,		15′
6. Rock and slate,		2′
7. Slate, gray,		3′ 6″
8. *Iron ore*,	*Mercer*,	1′
9. Slate, gray,		6′
10. *Iron ore*,		1′
11. Slate, light gray,		2′
12. Slate, black,		7′
13. Slate, dark,		8′
14. Slate, light colored,		2′
15. Slate, black,		4′
16. Fireclay,		6′
17. Slate, black,		3′ 6″
18. Sandstone,		2′
		135′ 6″

Here (No. 2) is quite a massive sandstone, which probably misled Prof. Rogers (Geol. Penna. 1858) into calling the coal bed beneath it (in the section) the "Tionesta Coal" underlying the *Homewood* (Tionesta) *Sandstone.*

The *Homewood Sandstone* is represented by Nos. 4 and 5 of this boring; for in the part of Lake township a very massive sandstone often immediately underlies the coal, and then, below the sandstone, may be seen the *Mercer Lower limestone*, shows that the Stoneboro' coal bed is the *Brookville Coal* as at Pardoe, Jackson Center, &c.

Nos. 8 and 10 come near the horizon of the *Mercer Upper limestone*, and doubtless represent the ores which so often accompany that stratum.

About one fourth of a mile south from the last locality the following record was obtained by boring:

Fig. 93. Mercer I. & C. Co. bore hole No. 2; Lake T.

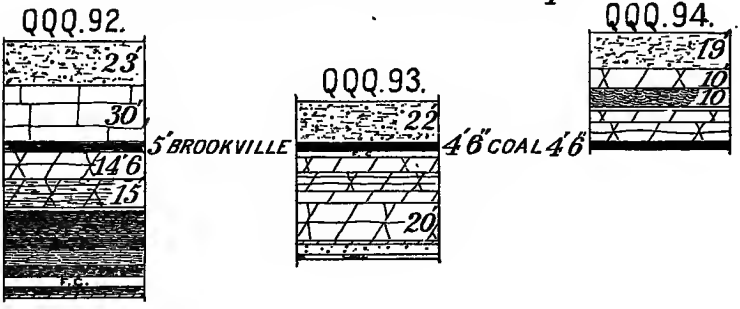
1. *Drift*,	22′
2. *Brookville Coal*,	4′ 6″
3. Fireclay,	3′ 6″

4. Sandstone, fine-grained,	*Homewood Sandstone,*	8′
5. Sandstone, white,		10′
6. Sandstone, gray,		6′
7. Sandstone, white,		20′
8. Sandstone, gray,		2·
9. Pebble rock,		5′ 6″
10. *Mercer Upper Coal (?),*		2′ 6″
		83′

Here the *Homewood Sandstone* (represented by Nos. 4 to 9) is altogether 52′ thick. The lowest layer of the rock is represented by the driller as very pebbly.

No. 10 is one of the *Mercer* coals, and as its distance below the Brookville is here 55 feet, it most probably represents the *upper* one, since we have generally found an interval of 70′ to 80′ between the Brookville and the *lower* one.

Sections in Lake Township.



One mile south-west from Stoneboro' a hole was drilled on the McKay farm, with the following result:

Fig. 94. McKay Farm bore hole; Lake T.

1. *Drift,*		19′
2. Sandstone, gray,	[*Clarion Sandstone?*]	10′
3. Shale, gray,		10′
4. Rock, gray,		2′
5. Sandstone,		6′
6. Sandstone, gray,		10′
7. *Brookville Coal,*		4′ 6″
		61′ 6″

This hole shows a considerable body of *Clarion Sandstone above* the *Brookville coal;* which nearly always happens when *Ferriferous limestone* is absent, or but poorly developed.

About one mile south-east from Stoneboro' another boring gave the following record:

Fig. 95. Bore hole 1 m. S. E. of Stoneboro' ; No. 1, Lake T.

1.	*Drift*	Surface debris,	20′	58′
2.		Sand, loose white,	15′	
3.		Gravel, mixed,	10′	
4.		Clay, blue,	13′	
5.	Slate, gray,		40′	
6.	*Brookville Coal,*		4′ 6″	
			102′ 6″	

The great thickness (58′) of the *Drift deposit* is here quite remarkable, and as we go further east it gets thicker still.

No. 2 is reported to be a bed of beautifully pure and almost white sand, which should be valuable for glass-making, and could be shipped to Pittsburgh to compete with sand from east of the mountains.

Another hole drilled just east from this gave the following section:

Fig. 96. Borehole, No. 2; Lake T.

1.	*Drift,*	Soil, gravel, sand, &c.,	60′	90′
2.		Clay, blue,	30′	
3.	Slate,		2′	
4.	*Brookville coal,*		4′ 6″	
			96′ 6″	

Here the *depth of the Drift* was increased to 90′, and the over-slates of the coal have been removed all except 2 feet; whereas in borehole (Fig. 95) close by, to the west, 40′ of slate covering to the coal remains.

Just south from this last hole another was drilled with the following record:

Fig. 97. Borehole, No. 3; Lake T.

1.	*Drift,*	Surface,	20′	51′
2.		Sand, white,	15′	
3.		Sand and gravel,	10′	
4.		Clay, yellow,	6′	
5.	Sandstone,		31′ 6″	
6.	*Brookville Coal,*		4′ 6″	
			87′	

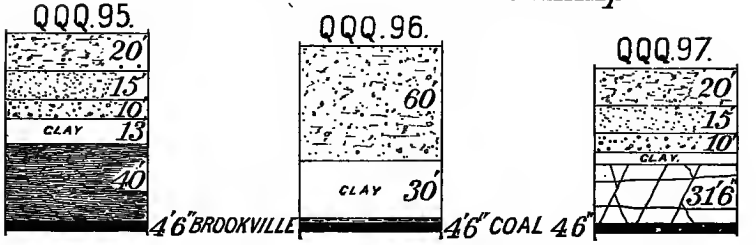
Here again the white sand reported in borehole Fig. 95 and of the same thickness is repeated.

Near this last another hole was drilled, giving the following record:

Fig. 98. Borehole, No. 4; Lake T.

1.	*Drift,*	Surface debris,	20′	52′
2.		Quicksand,	20′	
3.		Clay, blue,	12′	
4.	Slate, gray,		19′ 6″	
5.	*Brookville Coal,*		3′ 6″	
			75′	

Borehole Sections in Lake Township.



The white sand (No. 2) in this hole was mixed with clay, and thus had a tendency to ooze out and fill up the hole; hence the drillers termed it quicksand.

The Gray slate of the drillers (No. 4) is very probably a sandstone; for the word "slate" in the drillers' vocabulary is susceptible of a variety of interpretations.

About one and a half miles south-west from Stoneboro', the same company drilled a hole which gave the following record:

Fig. 99. Borehole No. 5; Lake T.

1.	*Drift*,			16′
2.	Slate,			17′
3.	*Brookville coal*,			4′ 6″
4.	Fireclay,			2′
5.	*Homewood Sandstone*,	Rock, gray,	9′	59′
6.		Sandstone, white,	20′	
7.		" gray,	10′	
8.		" white,	9′	
9.		" gray,	3′	
10.		" white,	8′	
11.	*Mercer Upper Coal*,			1′ 3″
12.	Slate,			8′
13.	Sandstone, white,			—
				107′ 9″

I am doubtful about identifying No. 11 with the *Upper Mercer Upper coal*, for it may with equal safety be considered the *Lower Coal;* but I am certain that it represents one or the other.

The *Brookville coal* at Stoneboro', has about the same appearance and quality that it has at Pardoe, at Jackson Center, and at other localities in Mercer County. It makes an excellent fuel for steam purposes, and is a very good grate coal; but it contains entirely too much sulphur for the manufacture of gas or iron.

A short distance north-west from the slope of the Mercer Iron and Coal Company, the outcrop of the *Homewood Sandstone* is seen near the head of a small stream, with a perpendicular cascade of 30 feet. The rock is very massive, and some of its layers contain pebbles.

Immediately below the *Homewood Sandstone* lies a bed of coal, which varies in thickness from 4 inches to 2 feet within about one rod; this is very probably the *Mercer Upper coal.*

Mr. Chance made the following section in the vicinity of Stoneboro', which he kindly placed at my disposal:

Fig. 100. Stoneboro' Section (Chance); Lake T.

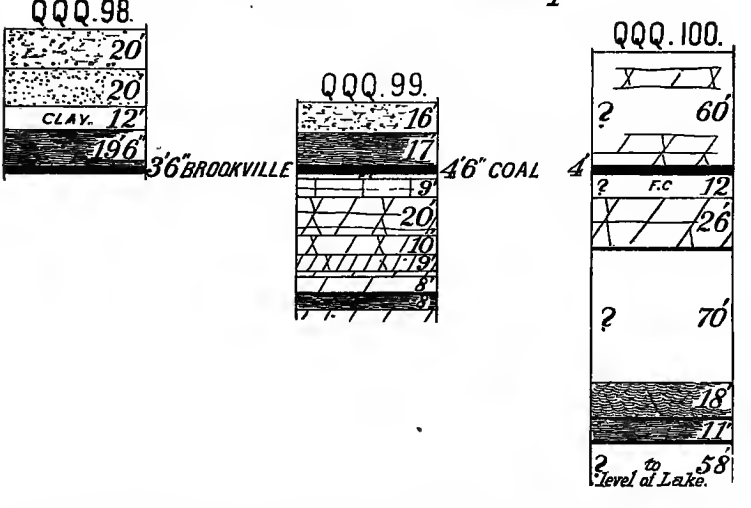
1.	Concealed, with some massive sandstone,	60′
2.	*Brookville Coal*,	4′
3.	Fireclay and concealed,	12′

4.	*Homewood Sandstone*, quite hard and massive,	26′	
5.	*Mercer Upper Coal*,	1′	
6.	Concealed,	70′	
7.	Shale, blue slaty,	18′	
8.	*Coal*,		1″ to 6″
9.	Slate, blue ahaly,	11′	
10.	*Quakertown Coal*,	2′	
11.	Concealed to the level of the lake,	58′	
		262′ 6′	

I did not see the coal (No. 8); but Mr. Chance states that it was plainly exposed when he constructed the section.

The *Quakertown Coal* (No. 10) is the same mined to run the oil well engine in Wild Cat Hollow, near Stoneboro'. Some one has attempted to open it just above the village, but it is too thin and slaty to be of any importance.

Sections in Lake Township.



About one mile west from Stoneboro', an *oil-well* was once drilled in a deep ravine called Wild Cat Hollow, on the land of Mr. Bromley, and there Mr. Chance constructed the following section, by combining the surface exposures with the record of the boring:

Fig. 101. Bromley Section (Chance's): Lake T.

0.	Surface, (1288′ above tide,)	0′
1.	Slate, bluish black,	5′
2.	Sandstone, massive, coarse grained,	17
3.	Shale, blue slaty,	2′
4.	Ironstone ore,	1′
5.	Slate, dark blue,	12′
6.	*Quakertown Coal*,	2′
7.	Shale, bituminous, slaty,	3′
8.	Sandstone, massive,	10′
9.	Sandstone, fine-grained, yellow,	13′
10.	Concealed,	10′
11.	Flags, thinly bedded, sandy,	15′
12.	Slate,	40′
13.	*Sandstone*,	80′
		210′

(No. 2) is seen here in a very bold cliff, and it is most probably the *Connoquenessing Upper Sandstone.*

(No. 4) is a very hard silicious ore, and several hundred tons of it have been mined here, and are now lying on the dump. It was tested in one of the Newcastle furnaces, but it proved too silicious, making only about 32 per cent. of metallic iron.

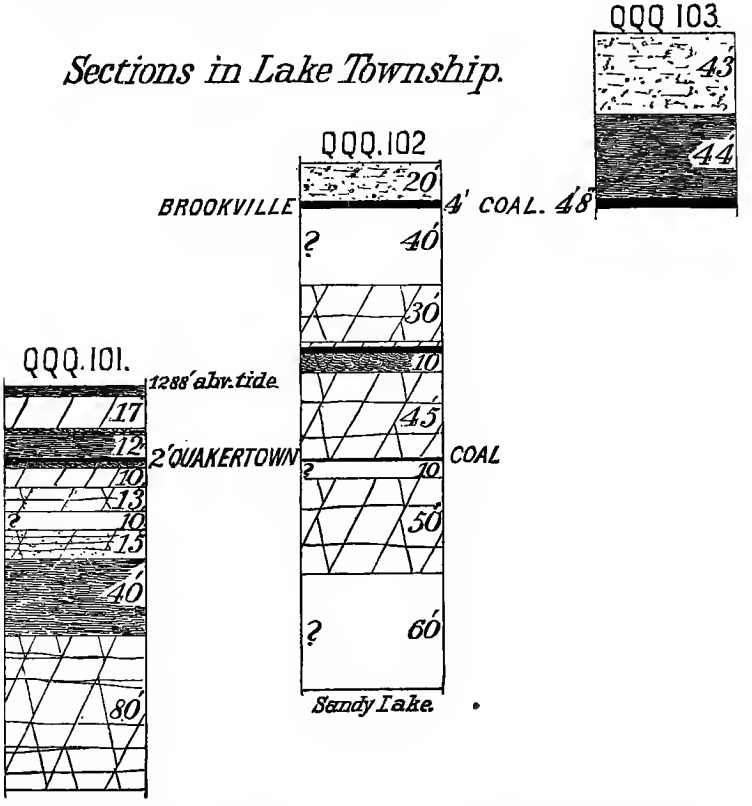
No. 6 comes at the horizon of the *Quakertown coal*, and doubtless represents that stratum. It is called the "third" or "lower vein" in the vicinity, and comes about 135 feet below the level of the Brookville coal. It was mined here in the hollow, and used to run the oil engine. It varies from 2′ to 2′ 6″ in thickness, and is somewhat slaty and sulphurous.

The *Wild Cat well* record I could not obtain; but Mr. Bromley gave me the following statements from memory: "Passed through the '*Mountain Sand*' at 172′; struck First Sand at 635′, and Third at 950.′ All the 'Red rock' found comes above the First Sand. The Second Sand was 140′ thick, and in it a show of heavy oil was obtained. Also a light yellow oil was found in the Third Sand, probably a ten-barrel well. Below the Third Sand *black slate* was found."

In the northern portion of this township the *Brookville*

coal was once mined on the land of Mr. Pringle at an elevation of 270′ above Sandy lake, but the workings are now abandoned.

In the north-eastern corner of the township 50 acres of the *Brookville coal* occupies an isolated knob, and is mined on the land of Mr. A. D. Lowry by a shaft 21 feet deep, which passed through 15 feet of *Drift* and 6 feet of dark slate; coal 4′ 9″; rich black luster; and of excellent quality for smithing. The coal bed, which overlies immediately (or within two or three feet) the *Homewood Sandstone* (60′ higher here than at Stoneboro', two miles south) has a ply of sulphurous slate near its middle.



At Mr. Lowry's house, which is some distance north from

the shaft, the *Homewood Sandstone* makes its appearance at the surface, and massive blocks of it lie scattered around.

Mr. White's well, a short distance north of Lowry's, went 35′ into it without reaching the base.

A short distance south of Lowry's coal works the same bed of coal was once extensively mined by entry on the land of Mr. Cushman; but the coal is now exhausted.

From Mr. Cushman's property a small stream descends to the north shore of Sandy lake. Passing down its rocky bed over almost vertical cliffs of strata, I made the following section:

Fig. 102. Sandy Lake (Cushman) Section; Lake T.

1.	Surface,	20′
2.	*Brookville Coal*,	4′
3.	Concealed,	40′
4.	*Homewood Sandstone*, massive,	30′
5.	*Mercer Lower (?) Limestone*,	3′
6.	*Mercer Lower Coal* ("*Second Vein*"),	2′ 6″
7.	Shales,	10′
8.	*Connoquenessing Upper Sandstone*, massive,	45′
9.	*Quakertown Coal*,	smut.
10.	Concealed,	10′
11.	*Connoquenessing Lower Sandstone*, massive,	50
12.	Concealed to level of Sandy Lake,	60′
		274′ 6″

The *Lower Mercer coal* (No. 6, known throughout this region as the "Second Vein,") was once opened along the ravine by Mr. Thompson; but it proved too slaty to mine profitably.

I have identified (No. 5) with the Mercer *Lower* limestone because 1. no other was seen below it, and 2. the interval between it and the *Brookville coal* is about right.

Immediately above it (where the sandstone does not cut it out) we find a layer of *iron ore* which was once dug out to a small extent near here.

The *Homewood Sandstone* (No. 4) forms a very steep bluff around the hill, and where the stream passes over it stands

out in a bold cliff; but its upper layers are concealed in the interval No. 3 and extend upwards to the coal bed.

The *Quakertown Coal* (No. 9) is the same mined at Bromley's in Wild Cat Hollow, but only shows its smut here. Rogers seems to have mistaken it for the *Sharon coal;* but this must come, if present, in the interval (No. 12).

Near the southern line of the township a shaft was once sunk to the *Brookville coal* by H. E. Hall and Co. on the land of Mr. Jas. Enfield. The material passed through, according to the statement of a man who worked in the shaft, was as follows:

Fig. 103. Hall & Co.'s shaft; Lake T.

1. *Drift,*	43′
2. Slate, gray,	44′
3. *Brookville Coal,*	4′ 8′
	91′ 8″

The coal was mined here for a short time, but the mine has been abandoned for several years.

In some holes drilled here the *Drift* was 65′ thick.

Mr. Enfield states that in many places a massive sandstone (25′ thick) was found above the coal.

Sandy Lake.

§ 71. This township lies between Lake township and the Venango county line.

It is drained by *Sandy creek*, which, entering from the northwest at its northern line, flows south to near its center, and then turning abruptly, passes eastward through Venango county into the Allegheny river; cutting down below the base of the *Conglomerate Series* before it leaves the township, amid wild and picturesque scenery.

The rock section in this township extends from the base of the Conglomerate Series, upwards, to forty or fifty feet above the *Brookville Coal.*

In the western part of this area, and south from Sandy lake, the *Brookville Coal* has been mined by the Mercer Iron and Coal Company.

About one mile west from the Venango county line, on the right bank of Sandy creek, the *Mercer Lower Coal* has lately been opened by the Oak Hill Coal Company, and preparations made to mine it on an extensive scale. The company has a tramroad and incline leading down to a switch on the Franklin branch of the Lake Shore and Michigan Central railroad. Coal, semi-block; coal bed, 2′ to 4′ thick; altitude, 220′ above Sandy creek;—roof, made by the *Mercer Lower Limestone*, 2′ 6″ thick, of a dark bluish color, and very fossiliferous;—floor, very pure fireclay, 3′ 6″ thick.

Descending the ravine from the mouth of the coal drift, we get the rocks in the following order: See p. 181.

Fig. 104. Oak Hill Coal Co. Section; Sandy Lake T.

1.	*Mercer Lower Limestone*,	2′ 6″
2.	*Mercer Lower Coal*,	2′ to 4′
3.	Fireclay,	3′ 6″
4.	Concealed,	70′
5.	*Quakertown Coal*,	Blossom.
6.	Concealed,	10′
7.	*Connoquenessing Lower Sandstone*,	90
8.	Concealed to the level of Sandy creek,	50′
		226′

Coal bed (No. 5) makes a small dark band alongside of the tramroad, and doubtless represents the *Quakertown Coal.*

The *Connoquenessing Lower Sandstone* (No. 7) forms a very massive cliff around the hill; is very coarse toward its base, and immense fragments of the rock have broken away and rolled to the base of the hill. This massive portion is also seen on the north side of the stream covering the slopes of the hill with huge *blocks as large as a house.*

Reed Furnace was situated where the road crosses Sandy creek, near the Venango county line. It is an old char-

coal arrangement, out of blast so long that everything is now in ruins. Its *ore* was obtained principally on the land of Mr. Wm. McClelland, who reports the following section of rocks, Fig. 105, at the old entry: See page 181.

Fig. 105. W. McClelland Ore Section; Sandy Lake T.

1.	*Mercer Lower Limestone,*	2′ 6″
2.	*Mercer Lower Coal,*	3′
3.	Fireclay and shales,	7′
4.	*Iron Ore,*	1′ 6″
		14′

He says that the ore was mined for a long time before an accidental fall of roof revealed the presence of the coal and limestone. The ore lay in a regular plate, and was quite rich. It resembles in situation the ore lying 15′ to 20′ below the *Mercer Lower Limestone*, near New Castle, in Lawrence county.

Throughout this entire region everything is deeply buried under Glacial Drift.

Crossing to the north bank of *Sandy creek*, which flows in a deep and narrow channel between cliffs of Conglomerate extending nearly to the hill-tops; and just under the road which leads up the hill, the *Mercer Lower Coal* has been extensively mined by Mr. Keho, for local supply; 3′ thick; 10′ beneath the *Mercer Lower Limestone*, visible above the mouth of the gangway; coal somewhat slaty, and with too much sulphur for smiths' use.

It is also mined on Reager's land, one mile above, 3′ 6″ thick.

Just at the Venango county line, a knob on the land of Mr. Barnes is high enough to take in the lower layers of the *Homewood Sandstone;* and here, where the Maple Grove Coal Co. has been mining, quite extensively, a bed of coal which overlies the *Mercer Lower Limestone*, descending from the summit of the hill, past the colliery, I got the following strange and remarkable succession: (p. 181.)

Fig. 106. Maple Grove Coal Works Section; Sandy Lake T.

1. *Homewood Sandstone,* massive,			30′
2. *Mercer Upper Limestone,*			2′
3. *Mercer Upper Coal,*			2′ 6″
4. Concealed,			40′
5. *Maple Grove Coal,*	1. *Coal,*	4′	9′ 6″
	2. Fireclay,	4′	
	3. *Coal,*	1′ 6″	
6. Shales,			6′
7. *Mercer Lower Limestone,*			2′ 6″
8. *Mercer Lower Coal,*			2′ 6″
			95′

I was at first inclined to regard (No. 5) as the *Brookville Coal*, and (No. 2) as the *Ferriferous Limestone*, thinned away; but the discovery of (No. 7), the *Mercer Lower Limestone*, put an end to the delusion, and introduced an important new element into the series, viz: A *Mercer Middle Coal* as local here, as in Lawrence county.

The gangway of the Maple Grove coal works enters the hillside about 20′ below the outcrop of the upper or 4′ bench (No. 5) which is the only one mined, and I was permitted to examine for myself the strata successively descending from roof to floor, to make my section.

The upper bench is a very fair coal, coming out in large rectangular blocks, of a brilliant black, and tolerably free from sulphur. The coal is shipped on a branch railroad to Raymilton, on the Lake Shore road, three miles away. The mouth of the entry is in Venango county, but the workings extend into Mercer.

The rounded top of the conical knob, capped by a cliff mass of the Homewood Sandstone, as above stated, has the elevation above tide (Chance) 1470′.

The *Upper* limestone (No. 2), light, bluish gray and quite fossiliferous, has been mined and burned to some extent.

The *Upper* coal comes immediately below it, and, where opened just below the quarry was reported 2′ 6″ thick, but quite slaty. Débris prevented me from verifying the statement.

The interval between the Mercer *Upper* and *Lower* lime-

stones (here 58′) is greater than I have seen it anywhere else.

The *lower* limestone (No. 7) is very hard and compact, and a mere mass of fossils; but an irregular stratum, often thinning away entirely, or resolving itself into widely separated large nuggets, or balls.

The *lower* coal, just under it, is not mined here, being quite slaty and bony, although mined by the Oak Hill Company, one and a half miles to the south-west.

Mr. Chance made a section at this same locality which he connected with the R. R. levels at Raymilton and kindly gave me for publication; it reads as follows:

Sections in Sandy Lake Township.

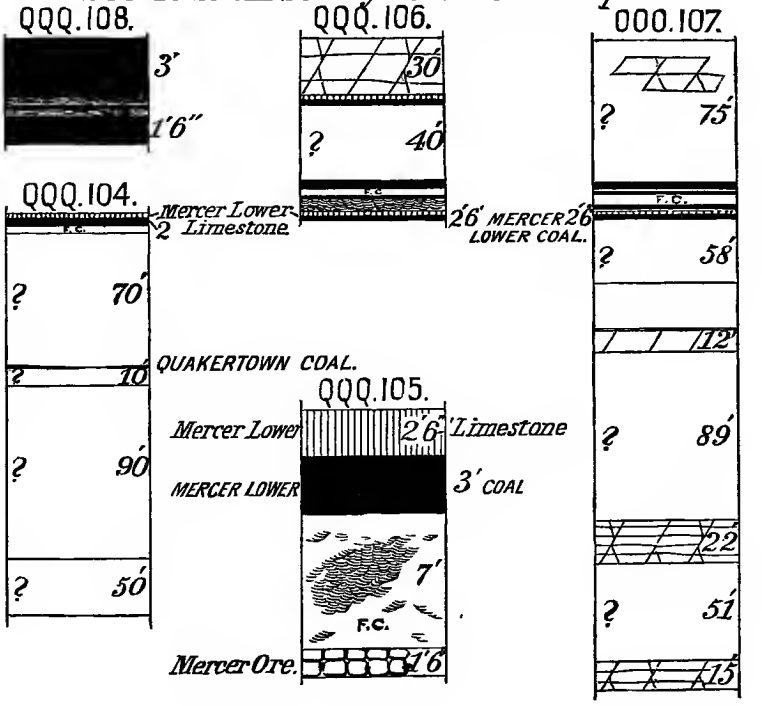


Fig. 107. Maple Grove-Raymilton Section by Mr. Chance.

1.	Concealed, with hard SS. above,		75′
2.	*Coal*,		4′
3.	Slate,		1′
4.	*Coal*, slaty,		1′
5.	Fireclay,	4′ to 6′	
6.	1. Slate,	2″ to 3″	1′ 8″
	2. *Coal*,	1′ to 2″	
	3. Slate,	2″ to 3″	
7.	Fireclay,		1′
8.	*Mercer Lower Limestone*,	1′ to 2′	
9.	*Mercer Lower Coal*,	2′ to 2′ 6″	
10.	Concealed,		58′
11.	Sandstone, massive,		12′
12.	Concealed,		89′
13.	Sandstone, flaggy; some massive beds,		22′
14.	Concealed,		51′
15.	Sandstone, fine grained; shale; down to railroad grade at Raymilton (1135′),		15′
			341′ 2″

In the north-western corner of this township, which extends in a kind of neck northward, a considerable area of the *Brookville coal* is caught in the summits of the highest hills. One of these areas occurs on the land of Mr. Sharpley and is there mined by a shaft 33′ deep; by barometer 1430′ above tide; coal, 4′ to 5′ thick; of fair quality for domestic purposes but rather too sulphury for smith's use.

Drift alone overlies it,—blue clay, intermingled with bowlders of granite, gneiss, limestone, sandstone, &c.

A short distance south from this the *Brookville Coal* is mined by gangway on the land of Mr. Bailey where it shows the following structure: See Fig. 108 on p. 181.

Fig. 108. Bailey's Coal Bank; Sandy Lake T.

1.	*Brookville*,	*Coal*,	3′ 0″	5′
2.		Slate,	0.5″	
3.		Coal,	3″	
4.		Sulphur band,	3″	
5.		Coal,	1′ 6″	

The upper 6″ to 8″ of the top bench (No. 1) is sulphurous, and left for the roof, as there is here also nothing but

Drift above it. Six inches of the bottom bench (No. 5) is very pure smithing coal worth hauling as far as Meadville.

The *Homewood Sandstone* immediately below the coal, and here very coarse and pebbly, makes a line of vertical cliffs around the hill.

Just below its base a coal bed was once opened on the land of Mr. Hogue, 3½ feet thick, but too slaty to warrant mining.

The *Brookville coal*, 4½′ thick, is also mined just north from Mr. Bailey's on the land of Mr. Patton by a shaft 25 feet deep.

Mill Creek.

§ 72. This township lies north of Sandy Lake along the Venango county line.

Most of its drainage waters pass east into the Allegheny river. Its south-western portion is drained into Sandy creek.

Its rock-section extends from the top of the *Homewood Sandstone* 220′ downwards, and its only important coal beds belong to the *Mercer group*.

Where the road crosses Sandy creek from the north-western corner of Sandy Lake and enters Mill Creek township the water level is 210′ (by barometer) lower than the level of Bailey's *Brookville coal* three fourths of a mile south.

A few rods below the road bridge, a trial *oil well* was once bored several hundred feet deep on the McElvain farm; but no oil of any consequence was obtained.

Just north of the well and near the Utica road, Mr. Killgore in digging a well went through one of the Mercer coals, 1′ thick, lying a little below the base of the *Homewood Sandstone*.

In the south-eastern part of the township a hole was once drilled for coal on the land of Mr. Clayton, 70 feet deep,

commencing on massive (*Homewood*) sandstone, and striking the coal (*Mercer Lower?*) 2′ 8″ thick, at 31′ below the base of the rock.

The *Homewood Sandstone* here makes long lines of cliffs near the summits of the hills on each side of North Sandy creek.

North-west from this, about three fourths of a mile, on Nicklon's land, we get the following section:

Fig. 109. Nicklon Coal Bank; Mill Creek T.

1. *Homewood Sandstone*, massive,	30′
2. Slate, black,	3′
3. *Mercer (Upper?) Coal*, impure,	3′
	36′

What of No. 1 is visible is coarse, and many of its layers are pebbly.

The coal bed (No. 3) is one of the Mercer Group; probably the *Upper* coal; here quite impure. The Welsh miner who contracted to open it persuaded Mr. Nicklon to believe that when once under cover (Nos. 2 and 3) would coalesce into a splendid coal bed 5 or 6 feet thick. It is needless to say that the mine was abandoned.

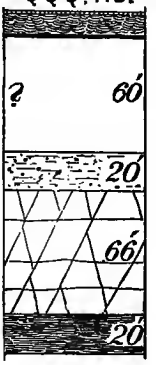
About one fourth of a mile west from Braden's mill on North Sandy creek, the *Mercer Lower limestone* (reported 2′ thick) was once quarried (and burned) by Mr. Glenn; 100′ below the hilltops and 125′ above the creek. The quarry has been neglected for several years and the bed is now concealed.

In passing up the hill road north from Braden's mill, the outcrop of a very massive sandstone is seen, 35′ thick, with its base 50′ above the stream. It is probably the *Connoquenessing Upper sandstone.*

One half mile north-east of New Lebanon a coal is mined on the land of Mr. David Grove, and there we get the following succession by combining the surface exposures with the records of a well which he bored for coal:

Fig. 110. New Lebanon Section; Mill Creek T.

1. *Mercer Lower Limestone*,	2′
2. Shale, gray slaty,	10′
3. *Mercer Lower Coal*,	2′
4. Concealed to mouth of drill hole,	60′
5. *Drift*,	20′
6. *Connoquenessing* Sandstone, hard, coarse,	66′
7. *Sharon Shales*, black slate,	20′
	180′



The *Mercer Lower Limestone* (No. 1) has been dug out of the hill and burned to a small extent. It is rather impure, of a bluish cast and quite fossiliferous.

The *Mercer Lower Coal* (No. 3) yields a very good fuel at this locality, having the structure of genuine "block," or "splint;" but its thinness makes mining difficult.

Mr. Grove reports that (No. 6) was a very hard sandstone, solid throughout.

No. 7 represents the dark bituminous shales which so often overlie the Sharon coal, and Mr. Grove states that the further they drilled in them the richer and blacker they became, so that had the drill gone a few feet further it is not improbable that the *Sharon coal* might have been found, since there is no doubt that this is the horizon where that coal should occur, since it always comes 160′ to 200′ below the *Mercer Lower Limestone*, and the interval at which the drill stopped below the horizon of the latter stratum is 178 feet.

New Vernon.

§ 72. This township lies west of Mill Creek and north of Lake.

Mill Creek flows diagonally through it from north-west

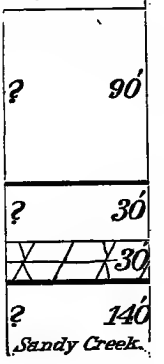
to north-east, and drains its northern and central portions; while the *Little Shenango*, passing north-westward across its western portion, carries that drainage in the opposite direction.

In this township we get some very elevated land, and one knob on Mr. Borland's property rises 90 feet above the level of the *Brookville coal*, and should catch the *Ferriferous limestone;* but everything is deeply buried under the *Drift.*

At this locality, a short distance south from Sandy creek, and about three fourths of a mile north of the center of the township, the following succession is obtained:

Fig. 111. Borland's Knob Section.

1.	Concealed from top of knoll,	90′
2.	*Brookville coal,*	?
3.	Concealed,	30′
4.	*Homewood Sandstone,* massive,	30′
5.	*Mercer Upper ? Coal,*	2′
6.	Concealed to level of Sandy Creek,	140′
		292′



An attempt was once made to open the *Brookville coal* (No. 2) here, but its only covering was *Drift*, and the attempt was abandoned before a coal bed of any thickness was obtained. Mr. Boreland states that before the entry stopped several inches of coal had been found, and great lumps of it were scattered through the Drift above, indicating that the bed had suffered much from *Glacial erosion.*

Mr. Boreland sunk a shaft here to the coal bed (No. 5), passing through the massive *Homewood Sandstone*, above it, for 30 feet. But it is much thicker, its top nearly reaching the level of (No. 2) at a place a short distance away, where it shows itself in cliffs.

(No. 5) is one of the *Mercer coals*, probably the *upper* one. It comes in immediate contact with the massive sandstone above, and is therefore subject to great variations in thickness, frequently being cut out entirely.

The coal is a kind of slaty, impure "block," containing much sulphur, and only used because nothing else can be obtained.

On the southern side of the high knob Mr. Voorhies once made an attempt to open the *Brookville coal* but without success, as it there had no roof covering but the *Drift*, which could not be kept up except by a continuous roofing of boards, which was too expensive.

In the north-western corner of this township, and just below School House No. 3, Mr. Perrine has lately tried to open the coal to which Mr. Boreland sunk the shaft. He drove an entry into the hill about one rod, and found 2 feet of coal so slaty and worthless that he gave up the enterprise.

The massive *Homewood Sandstone* is there seen jutting out of the hill above the coal, which represents either the *Upper* or *Lower Mercer*, as there are no exposures below the horizon of the coal. It lies here 10 feet (by barometer) below the level of the coal at Boreland's, 2½ miles east, and is about 1300′ above tide.

Perry.

§ 73. This township lies west of New Vernon and north of Fairview.

It is drained entirely by the waters of *Little Shenango*, which flows north-westward diagonally across it. Near its southern margin *Half Moon Swamp* (mentioned in connection with Fairview township) lies (by barometer) 1360′ above tide, and is reported the highest place on the turnpike between Pittsburgh and Erie; the road being laid through the swamp on heaps of logs and saplings.

Just north of the swamp a trial hole was bored, on Mr. Boggs' land, and 18 inches of coal found, at a depth of 75 feet; one of the *Mercer coals;* lying not far beneath the *Homewood Sandstone.* Water was struck at 50 feet, which still flows copiously. No higher land is found within several miles of the place, and no gas accompanies the water.

On the land of Mr. Mizener, one mile south from Hadley station, a *bed of iron ore*, 1′ to 1′ 6″ thick, was once mined for the old charcoal furnace at the western line of the township; at the horizon of the *Mercer Lower Limestone*, 225′ above the railroad grade at Hadley station, or 1295′ (by barometer) above tide.

About 5 feet below the level of the ore bed, a bed of good coal, 14″ thick, was once stripped on the lands of Mr. Goodrich and Brushmoyer.

About one mile north from Hadley, the *Mercer Lower coal* is mined by an entry on the land of Mr. John Smith. It is here a genuine block coal in appearance, but contains considerable sulphur and a large amount of ash. The bed varies greatly in thickness, running up to 3′ and down to 18″. It is here 25′ higher than on the south side of the Little Shenango at Mizener's, being 1320′ above tide.

In the vicinity of Hadley, the Little Shenango cuts down below the horizon of the *Sharon coal*, but no bed is seen or reported, so that it is doubtless absent.

Otter Creek.

§ 74. This township lies west of Perry and north of Delaware.

The *Little Shenango* forms its northern boundary, and drains that portion of its surface. *Otter creek* heads in its central region, and drains its southern half into the Neshannock. Very little of its geology can be made out, for its surface is covered with *Drift*, effectually concealing nearly all the underlying rocks.

Harry of the West Furnace was situated near the eastern line of the township. Built about 45 years ago, it has long been out of blast. It used charcoal and native ore exclusively, obtained from the horizon of the *Mercer Lower*

limestone; and varying in thickness from 1′ to 3′; three tons of ore to one of iron; quality of iron excellent. Its flux was obtained from the *Mercer Lower Limestone* bed on Mr. Slater's farm, in Fairview township.

At many places along the Little Shenango R., we see traces of the ancient *Glacier;* for example:

Deep striæ cut upon the lower layers of the Conglomerate, on McNight's land, along the road a mile south of the Little Shenango creek; general direction of the striæ, south-east, or nearly parallel to the course of the creek; scratches from $\frac{1}{4}''$ to $\frac{1}{2}''$ deep, on a smoothly planed surface of rock.

As we pass down the hill road, below the level of the the Conglomerate, Glacial scratches are seen on the shaly rocks of the Cuyahoga group, many of which seem to have been broken up and pushed out from their original bedding.

Another noteworthy feature, is that *the solid rock crust seems to have been ploughed off, and given the same slope as the surface now possesses*, which would seem to indicate that in this locality the moving ice conformed in its grinding and ploughing action to the original shape of the valley.*

Hempfield.

§ 75. This township lies west of Otter Creek, and has the Shenango river for its western boundary.

Crooked creek, along which the old Beaver and Erie canal passes, enters the northern part of the township, and, flowing south, unites at Greenville with the Shenango river, which receives the entire drainage.

Glacial scratches are to be seen in all parts of the township wherever the underlying rocks are uncovered. For example:—

[* The erosion of which must therefore be assigned to a *preglacial* age.—J. P. L.]

A high knob, near the southern line of the township (a short distance north from the Salem Presbyterian church) capped by *Conglomerate*, the upper surface of which along the road is well exposed and deeply scored with glacial markings, *two series of scratches are visible crossing each other;* one set in a nearly south-east direction; the other south-south-east; the S. S. E. set being the larger; some of them as much as *two inches deep and eight inches broad.*

On the northern slope of the hill the rock has been planed off by the ice and left with the same slope as the present surface.

The Conglomerate, exposed along the tops of many of the highest hills in the township, seems to be in almost every case, massive and compact and well fitted for preserving the marks of the passage of the ice.

In the vicinity of Greenville one notices a broad and level *terrace*, at 15′ or 20′ above the level of the Shenango river. Back from this rises another well marked *terrace*, 60′ above the stream.

No coal has ever been found in this township, so far as I could learn, though many of its hills pass up above the level or horizon of the *Sharon coal.*

Near the southern line the *Sharon Conglomerate* has been quarried on the land of Mr. McMillen; a very coarse-grained, reddish-white rock; working readily into an excellent building stone.

Near the south-west corner a very high knob is capped by the *Sharon Conglomerate*, a coarse grayish-white sandstone, once extensively quarried for building the canal locks. Its top is planed off smooth by *Glacial action, two series of scratches being again seen;* the stronger or deeper set going S. 20° E.; the other nearly S. E.

West Salem.

§ 76. This township lies west of Hempfield, north of Pymatuning, and along the Ohio State line.

The *Shenango river* flows south along its eastern border; but the most of the drainage is carried off by *May's creek* which rises near the northern line of the township and flowing south-east through its center empties into the Shenango at its south-eastern corner.

Here we get the final outcrop to the north of the *Sharon coal bed;* for, in the vicinity of Greenville is the furthest point to the north at which it has ever been mined in Pennsylvania.

The section of exposed rocks in this township extends from 100′ above to 280′ below the *Sharon coal;* including therefore all of the Cuyahoga shale and possibly a part of the Bedford shale formations of Ohio.

The surface of the township is covered with a thick coating of *Drift*, and its topography evinces extensive *glaciation; glacial scratches* moreover may be noticed furrowing the surfaces of rocks on the high lands wherever the Drift has been removed.

Just west from Greenville, near the eastern line, a long, high tongue of land catches a considerable area of the *Sharon Coal.*

About one mile west from Greenville it was once mined quite extensively by the Greenville Coal Company. Connecting the surface exposures with the rocks seen in their slope, we get the following Section: Fig. 112, page 193.

Fig. 112. Greenville Coal Co. Section; West Salem T.

1. *Drift*,	15′
2. *Connoquenessing Lower Sandstone*,	25′
3. Shales, dark,	24′
4. *Sharon Coal*,	4′
5. Concealed,	10′
6. *Sharon Conglomerate* sandstone, massive,	5′
7. Flagstone,	10′
8. Concealed,	40′
9. *Shenango Sandstone*, massive, ferriferous,	20′

10.	Shales, bluish,	10′
11.	Concealed,	80′
12.	Sandstone, flaggy,	10′
13.	Concealed to level of Shenango,	80′
		333′

This section is connected with the *flagstone quarry* of Leech Bros., and descends a ravine to the Shenango, just northwest from the station of that name, one mile below Greenville.

The *Connoquenessing Lower Sandstone* (No. 2) is here very conglomeratic, having pebbles as large as a chestnut.

The *Plant Bed* (No. 3) is a dark shale, and in many places contains quantities of vegetable remains.

The *Sharon Coal* (No. 4) was once mined extensively here for local supply. It contains a considerable amount of pyrites, and is too impure for iron making, hence it was used only for grate and steam purposes.

The *Sharon Conglomerate* (No. 6) is a coarse, brownish, massive rock, the top of which is covered with iron stains and blotches.

Fish Bed.—In the upper portion of the rock we also see many fragmentary *remains of fish*—bones, teeth, and scales, all in a broken and imperfect condition, giving evidence of rasping and grinding by the coarse sands of which the matrix is composed.

The quarry is half a mile from where the *Sharon Coal* is seen, and the difference of level between the bottom of the coal and the top of the rock is 10 feet; but it is probable that the actual interval is only two or three feet.

The sandstone (No. 6) passes down imperceptibly into the flagstones (No. 7) which are merely the lower layers of the *Sharon Conglomerate* become flaggy; and this is the bed from which the famous *Greenville flags* are quarried. The layers vary from two to eight inches in thickness, and beautiful flagging of almost any desired size, with surfaces as smooth as a board, can here be taken out. The layers of rock seem to thicken up, and the bed-planes become less numerous when followed back into the hill; and it is quite

possible that still further back the flaggy portion would form a continuous solid mass with (No. 6).

At the quarry of the Leech Bros. many specimens of flags were seen 12 feet long by 8 feet broad, and any intermediate size could be obtained.

The *Shenango Sandstone* (No. 9) is a massive rock, and here forms a bold cliff along the hill. It contains many balls of iron ore, as well as *fish remains*, and was once quarried extensively. The rock is of a buffish-white color, much stained with iron.

A short distance south from Leech's quarry Mr. Appenburger has a quarry in the *Connoquenessing Lower Sandstone*, and, passing from it down a ravine to Shenango Station, on the Erie and Pittsburgh railroad, we get the following Section:

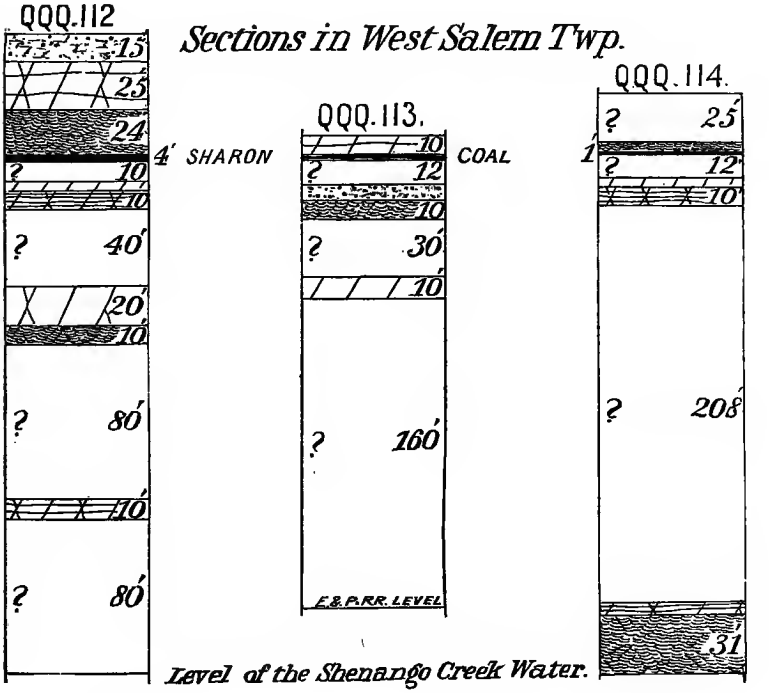


Fig. 113. Appenburg's Quarry Section; West Salem T.

1.	*Connoquenessing Lower Sandstone,*	10′
2.	*Sharon Coal,* in streaks, in shale,	3′
3.	Concealed,	12′
4.	*Sharon Conglomerate,*	8′
5.	Shales, sandy,	10′
6.	Concealed,	30
7.	*Shenango Sandstone,* massive, ferriferous, seen,	10′
8.	Concealed to E. & P. R. R., Shenango Station,	160′
		243′

The Connoquenessing Lower Sandstone (No. 1) is a hard grayish-white sandstone, *with a great tendency to false bedding.** It is difficult to work but makes an enduring building stone.

The (No. 2) immediately under (No. 1) is a dark sandy shale, through which run many streaks and strings of coal. It represents the Sharon bed without any doubt.

Sharon Conglomerate.—In (No. 4) we have an example of those great and rapid changes of character which mark the rock immediately below the *Sharon coal.* Instead of the sandstone and flagstone layers of the last section at Leech's quarry, a short distance away, we have here a mere *mass of quartz pebbles loosely cemented* in a matrix of coarse bluish and gray sand, and occupying also nearly all the interval (No. 3); this however was so covered up by falls from above that I could not determine the fact. The pebbles in (No. 4) are quite variable in size, but the greater portion are larger than a hazle-nut, and some approach the size of a hickory-nut; most of them are ovoid and have a water-worn appearance.

The *Shenango Sandstone,* of which (No. 7) is a portion, contains here, as everywhere else, a large amount of iron in the shape of spherical, or ovoid balls, some of them ocherous and others *calcareous.*

Mr. Appenburger has another quarry in the Greenville flags just across the road from the Leech Brothers, and I

[* It should be remembered that this is the prime characteristic of the Pocono Formation, No. X (Vespertine), in Middle and South-western Pennsylvania. J. P. L.]

noticed there many slabs of rock beautifully marked with *rain drops* and *ripple marks.*

Just west from Greenville, about one fourth of a mile, there is another flag quarry at the roadside, operated by Mr. Isaac Amy.

Here the following section was obtained by connecting with an entry on the Sharon coal, only a few rods above: See Fig. 114 on page 194.

Fig. 114. Amy's Quarry Section; West Salem T.

1.	Concealed from surface,	25′
2.	Shale, black,	5′
3.	*Sharon Coal* (3′ thick in the mine),	1′
4.	Concealed,	12′
5.	*Sharon Conglomerate*, sandstone, coarse, massive,	5′
6.	Flagstone,	10′
7.	Concealed,	208′
8.	*Sharpsville Sandstone*, flaggy,	7′
9.	Shales, bluish, weathering to rusty, visible to the bottom of the Shenango river at Greenville,	31′
		304′

The *Sharon coal* (No. 3) is only one foot thick where I measured it at the outcrop, but further back in the hill it thickens up to 3 feet.

Part of interval (No. 4) is doubtless occupied by the *Sharon conglomerate* (judging from fragments on the surface) and the rock exposed (as No. 5) is the same as at Leech Brothers. It is split up into rectangular blocks here, and sold for building stone.

The flagstone (No. 6) also does not differ from the flagstone at Leech Brothers' quarry; has a bluish-gray color; many of the flags *ripple-marked;* but no fossils of any kind seen.

The *Sharpsville Sandstone* (No. 8) may be studied in a railway cutting just above the dam at Greenville; a hard, dark-grayish rock; in layers 6″ to 1′ thick; the base of the Sharpsville Sandstone mass; upper portion concealed in the interval (No. 7).

The *shales* (No. 9) have a dark-bluish color, and contain many scattered iron balls, so that its exposures turn rusty brown.

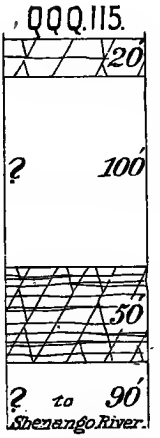
Lingula bed.—Near the level of the creek I noticed in these shales immense numbers of *Lingula melie;* but no specimens of *Discina.*

Just south from Mr. Amy's there is another quarry in the same flags on the land of Mr. Bortz.*

Near the northern line of West Salem township, and on the right bank of the Shenango, I got the following section:

Fig. 115. Shenango River Section, N. line of Salem T.

1.	*Shenango Sandstone*, massive, ferriferous, .	20′
2.	Concealed, ...	100′
3.	Sandstone, flaggy (Berea Grit?), ...	50′
4.	Concealed to Shenango river, ...	90′
		260′



A great many blocks of *Shenango Sandstone* (No. 1) are here scattered over the hill, some of immense size. The rock contains much iron, and makes a cliff near the top of the hill.

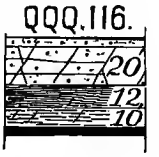
* It is a fact worthy of notice that all of these flag quarries are situated about the sources of little streams where the water from the same flows directly over and penetrates the rock, and that when the quarrying is carried in under the hills the layers of flags get thicker and the division planes disappear. This fact would seem to indicate that exposure to atmospheric influences has had something to do in forming the division planes, and that they are not entirely due to sedimentation.

No. 3 is very well exposed where the little stream cuts through it, and is seen standing out in steep bluffs along the ravine, made up of fine-grained, brownish-drab layers (1′ to 5′ thick) sometimes separated by shales (2″ to 6″ thick).

One mile west from Greenville the *Sharon coal* is now mined by Mr. Heilig. The mine is called the Chestnut Ridge coal bank, and the coal is reached by a shaft, in which is seen the following succession:

Fig. 116. Chestnut Ridge Coal bank Section; W. Salem T.

1. Surface soil, &c.,	5′
2. Sandstone, conglomeratic,	20′
3. Slate, bluish black,	12′
4. Slate, gray; called "Flint Rock,"	10′
5. *Sharon Coal*,	4′
	51′



Connoquenessing Lower Sandstone: (No. 2); the lower layers of are a mere mass of pebbles.

Mr. Heilig calls (No. 4) the "flint rock," from its extreme hardness and the trouble it gave him in sinking his shaft.

The *Sharon coal* (No. 5) extends through the hill from this locality to the works of the old Greenville Coal Company; is a *block* coal; but contains considerable sulphur and is only used for domestic purposes. The bed, lying in a kind of basin, thins away from the middle of the area in every direction.

In the south-western portion of the township is a small area of the *Sharon coal* on the land of Mr. Simpkins; mined for 40 years (by entry) near the cross-roads, a mile from the south line of the township; the bed varying in thickness from 0′ to 4′; and containing considerable pyrites.

Just east of this the *Sharon coal*, 3′ thick and of fair quality, is mined, lying 45′ beneath the surface. The slope was sunk in *Drift*, leaving only 8′ of a dark slate *containing quantities of well preserved fossil plants* above the coal.

Among these plants I saw *Alethopteris lonchitica* and great numbers of *Cordiates*.

All along the southern margin of the township stretches a productive area of the *Sharon coal*, mined from Pymatuning township by the Morris Coal Company.

Near the north-western corner of the township a high ridge takes in the *Sharon conglomerate*, in the vicinity of West Salem village or Mosmantown, as it is sometimes called.

At the very western line of the township the rock has been quarried, alongside of the road. Here I saw the cast of a large spine of *Ctenacanthus* in the upper portion of the rock, which is a coarse brownish white sandstone, making a good building stone.

Greene.

§ 77. This township stretching along the Ohio State line, north of West Salem, occupies the north-west corner of Mercer county.

It is deeply covered by *Drift*, and except in a few instances the rocks are entirely concealed.

There are only a few knobs in the township which attain an elevation sufficient to catch the *Sharon conglomerate*, and the streams cut down nearly 300 feet below its level.

It is drained by the *Shenango river*, which enters it from Crawford county near the middle of the north line, and flows south-easterly.

Near the north-eastern corner of the township, on the land of Mr. John Anderson, in an elevated ridge, the *Shenango Sandstone* has been quarried to a considerable extent; its top (by barometer) 1220′ feet above tide; 20′ thick; finely exposed along a small stream; the lower layers filled with balls of iron ore; and one of them with many *fish remains*.

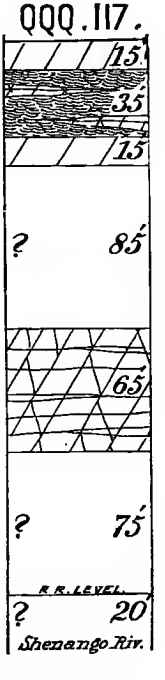
Immediately below it is seen a bluish shale; 20′ exposed in the ravine.

On the opposite side of the road the top portion of the *Shenango Sandstone* is exposed, and has been quarried on the land of Mr. Mahan; is whiter and freer from iron ore balls than the lower part, and an excellent building stone.

Going north from this the land rises, until at the edge of Crawford county, north-east from Jamestown, the hills catch the *Sharon Conglomerate;* quarried by Mr. Snodgrass. Descending from the quarry by the road to Jamestown, I compiled the following section:

Fig. 117. Snodgrass' Quarry Section; Greene T.

1.	*Sharon Sandstone*, coarse, massive, . . .	15′
2.	Sandstone, flaggy; sandy shales, . .	35′
3.	*Shenango Sandstone*, massive, ferriferous, .	15′
4.	Concealed, ...	85′
5.	Sandstone, fine grained, (Sharpsville,) . . .	65′
6.	Concealed to RR. (979′ above tide,)	75′
7.	Concealed to Shenango river (959′), .	20′
		310′



The *Sharon Conglomerate* (No. 1) is here a coarse grained yellowish looking sandstone; its top covered with blotches of iron stains. Organic markings are abundant near its

top, principally of broken *fish bones*, *teeth*, *scales*, *&c.*; and the layers here are almost exactly those immediately overlying the flagstones at Greenville,

But (No. 2) is rather shaly, and shows a structure very different from that of the rocks occupying this horizon at Greenville, in West Salem township; for there they furnish beautiful flagging; while here the layers are very irregular and uneven. All of (No. 2) is not exposed, but enough is visible to make it certain that it is all of pretty much that character.

The Shenango Sandstone (No. 3) is seen at the roadside just below the bridge, and has also been quarried. It contains great numbers of iron ore balls, 1″ to 1½″ in diameter.

(No. 5) is quarried in a hollow back (north) from Jamestown, and is there seen to consist of layers of sandstone 1′ to 2′ thick, separated by bluish-gray shales of variable thickness. Not all of (No. 5) is seen here, but the rest of it is fairly well exposed in a ravine further to the east.

Commencing near the base of this stratum, a trial *oil boring* was once drilled, and the following record of it was given to Mr. Carll by Dr. Gibson: (Fig. 118.)

Near the southern line of this township Mr. Alex. Fletcher has a quarry in the Sharpsville Sandstone, and there the rock is exposed for 70 feet in a ravine, along which the stratum forms perpendicular bluffs. The layers are here 3′ to 4′ thick and some of them are quite massive.

The base of the rock comes 60 feet above the level of the Erie and Pittsburg railroad.

Sugar Grove.

§ 78. This township lies along the Crawford County line next east of Greene.

Crooked creek, a dark sluggish stream, enters from Crawford county and, flowing south through its entire length, drains the township. It receives *Little Shenango creek* as a tributary from the south-east near the southern line.

Fig. 118. Jamestown Oil Boring; Greene T.

1.	Slaty "Soapstone;" streaks of hard rock,	90′
2.	Sand, fine blue,	20′
3.	Slate, blue,	65′
4.	Sand, coarse, light color,	?
5.	Slate, blue,	?
6.	Sand at 290′	
–	Struck oil of 29.5 gravity at 295′	
7.	Sand, coarse, pebbly,	18′
8.	Slate, soft, and soapstone,—308′ to 400′	92′
9.	Red Rock and hard shale,	100′
10.	Slate, hard and very close,	50′
11.	Slate, black, (to bottom of hole at 750′)	200′
		750′

The whole of the township has been *glaciated*, and is so deeply buried by *Drift* that only on some of the highest summits are any exposures visible.

On the top of the elevated hill south from Leech Corners the *Sharon Conglomerate* is exposed along the road. *Glacial striæ* passing across its surface from north-west to south-east, vary in depth from a quarter to half an inch.

Other scratches on it are seen at the summit of a hill, between Leech Corners and Kennard.

Salem.

§ 79. This township stretches along the Crawford County line next to Sugar Grove.

Little Shenango creek forms its southern boundary, and drains the larger portion of its area.

Its surface is covered with *Drift* so that very few exposures can be seen.

The northern and central parts rise high enough to take in a portion of the *Homewood Sandstone*, in scattered patches; underneath which at some localities the *Mercer coals* make their appearance.

One of these is just north-west from Salem Centre along *Lindsay's run*, on the land of Mr. Ausburn. Here it was mined several years ago; 2′ to 3′ thick; quite impure; and so near the surface that no roof could be obtained; the *Drift* extending down to the coal, except in a few isolated spots.

The coal lies here (by barometer) 50 feet higher than that mined at Wallace's in Sandy Creek township, 2½ miles further east, or 1350′ above tide. It is probably the *Mercer Lower Coal.*

Sandy Creek.

§ 80. This township lies along the Crawford county line, next east of Salem.

It is drained chiefly by *Sandy creek*, which enters it from Crawford county near the middle of its north line, and passes through it south-eastwardly.

Near the west line a coal bed is mined on the land of Mr. Wallace at an elevation above tide (by barometer) of 1,300′. The coal bed underlies a massive sandstone, and varies from 2 to 2½ feet in thickness; a kind of impure "block" coal; which contains considerable pyrites. It has been mined here for a long time, and more than fifty years ago was hauled to Meadville.

Just above it there is often found a bed of *iron ore* which was once mined for Mineral Ridge furnace in Perry township.

Sometimes a layer of *ore* occurs below the coal also.

The massive sandstone above it is the *Homewood* and the coal represents one of the Mercer group; probably the *Lower*.

Just on the other side of the run from Mr. Wallace's bank, a company from Oil City attempted to mine this coal bed on an extensive scale, and ship it on the Jamestown and Franklin railroad; but after spending several thousand dollars, the coal proved too slaty for anything except limited domestic use.

Near the southern line of the township half a mile south from Sheakleyville a high ridge extends up to and includes a portion of the *Homewood sandstone;* and a short distance under it comes the coal bed which has been mined in Perry township on the land of Mr. Smith.

Deer Creek.

§ 81. This township lies along the Crawford county line, east of Sandy Creek township.

Sandy Creek flows across its southwestern corner, and is its chief draining stream.

There is nothing of any particular interest to be found in

this township, since only one or two knobs rise high enough to catch the *Homewood Sandstone*, or its underlying coals.

One of these knobs is on the land of Mr. Ross, near the center of the township.

Ancient Diggings.—In the top of this knob several deep pits have existed from the earliest times known to the white people. One of them is reported to have been walled when it was explored in former years. Tradition locates here the lead mines of the Indians, and a few years ago a "practical miner" was set to work by a company to find them. He sunk several shafts to a depth of 35 or 40 feet, mostly in the *Homewood Sandstone*, but of course found nothing.

French Creek.

§ 82. This township lies along the Crawford County line, next east of Deer Creek; in the north-east corner of Mercer and against the Venango County line to the east.

French creek flows through its north-east corner, and as it leaves the county, receives *North Deer creek* as a tributary, which drains nearly all of this township.

This township contains some very elevated land, and although it lies so far to the north some of its hills rise high enough to take in the base of the Lower Productive Coal Measures. Some of them are even high enough for the *Ferriferous limestone*, if it escaped erosion previous to the deposit of the *Drift*.

Along French creek which cuts deep we have a horizon about 250 feet below the base of the Conglomerate Series; but exposures are few.

The *Mercer Lower limestone* is found near the southern line of the township and has been quarried to a small extent on the lands of Messrs. Fulk, Moore and others.

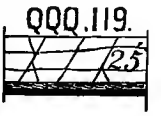
This shows that the *Mercer limestone* group reached far to the northwest.

About three fourths of a mile north-east from Milledge-

ville one of the *Mercer coals* is mined on the land of Mr. John Fulk. It comes immediately under the massive *Homewood Sandstone*, and shows the following structure:

Fig. 119. Jas. Fulk's Coal bank; French Creek T.

1. *Homewood Sandstone*,		25′	
2. Shale,		0′ to 3′	
3. *Mercer* coal,	Coal,	6″	2″ 2″
	Slate,	3″	
	Coal,	1′ 5″	
		30′ 2″	



The coal (No. 3) burns quite well and is used for smithing purposes.

The *Homewood sandstone* (No. 1) above it is very massive and conglomeratic, and many huge blocks of it lie scattered over the hill. No limestone is seen in connection with the coal, and there is no knowing whether the coal be the *upper* or *lower* bed. It lies (by barometer) 1385′ above tide.

Along North Deer creek, just above the cross-roads at Mr. Burrow's, 30 feet of bluish argillaceous rocks are exposed in a steep bluff. Their horizon is 300 feet below the level of the coal at Mr. Fulk's.

In the vicinity of Evans' bridge across French creek, a *wide and level terrace* is seen at 100 feet above the level of the stream. It seems to be composed principally of glacial debris.

About one mile south from Milledgeville, a coal has been mined by Mr. S. Moore, on the rignt bank of North Deer creek, and 180 feet above the water.

It comes at the same elevation as the coal mined by Mr. John Fulk, and is doubtless the same bed. It is generally only about 18″ thick, and is slaty at that, having a layer of slate 3′ 6″ thick near the middle. The coal below the slate is of the "block" type, while that above is more bituminous. At the head of the entry the coal was 21″, and the slate band was somewhat mixed with coal.

Below this bed, 100 feet, is seen the outcrop of a massive

sandstone, which is doubtless a portion of the *Connoquenessing Lower*.

One mile west from Milledgeville this same coal has been opened by Mr. Chately, and there it occurs with the following succession:

1. Iron ore,		8″
2. Shales,	4′	
3. *Coal*,	1′	3″

No. 1 is a limestone ore and doubtless represents the *Mercer Lower limestone*. It is quite rich, and would probably yield 50 per cent. of metallic iron.

No. 3 is very probably the *Mercer Lower coal*, and although so thin it furnishes a considerable amount of fuel, and is of tolerably fair quality.

Just west from Mr. Chatley's the blossom of this coal is seen along the road.

This same coal has been mined in this vicinity by Mr. Grutes, and also by Mr. Johnson.

South from this near the Deer Creek church the *Mercer Lower limestone* occurs at the same elevation as the iron ore at Chatley's and was once quarried and burned by Mr. Cooper. It was quite earthy however and did not slack well.

INDEX TO REPORT QQQ.

Index (A) of Personal Names mentioned in QQQ.

Index (B) to Geographical Names mentioned in QQQ.

Sections.

Index (C) to geological facts mentioned in QQQ.

Index (D) to the beds in their geological order from above downward, mentioned in QQQ.

The Glacial, or Northern Drift.

Local Coal?

Homewood Sandstone.

Mercer Lower Limestone.

Mercer Lower Coal, (Four Foot).

Sharon Upper Shales and Ore.

Sharon rider-coal beds.

Sharon roof Sandstone.

Sharon roof plant bed.

Sharon coal bed.

Sharon Under-ore.

Sharon Conglomerate.

Sharon flags.

Shenango Shales (Cuyahoga?)

Shenango Sandstone (Upper Berea of Read.)

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